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"The Constructive Radical"

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*FOG*

NEW YORK'S QUEENSBORO BRIDGE. ITS SPANS OF 1,182 FEET ARE AMONG THE LONGEST CANTILEVERS IN THE UNITED STATES

THE TECHNOLOGY
REVIEW
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# ART AS AN AID TO INDUSTRY

## *"There Is a Higher Work for Art than the Arts"*

BY GERRIT A. BENEKER

IN 1919 a steel mill in Cleveland put me on its executive staff, built me a studio close beside the tall factory chimney, and gave me *carte-blanche* to paint and write what I wished. A few months later I was put on the industrial relations advisory board of the company.

Why not? Why should not a steel mill employ an artist? Did not the great Rubens act as a negotiator between England and Spain, and did he not induce Velasquez, a Spanish youth of twenty-four years, to paint "The Forge of Vulcan" — a masterpiece of peace propaganda no less than of painting? Here in my studio beside the chimney of the power house was the opportunity to make art serve to increase goodwill and understanding between capital and labor, to reveal man to himself and to his fellow men.

Desiring first to do a portrait, I went in search of a man and the young vice-president suggested that I look up a chap named Peggy Hirsch, a truck driver. The transportation manager did not want to let him off, saying, "Can't you pick someone else? Peggy is worth any two truck drivers in Cleveland." Of course, this made me want Peggy all the more and we went in search of him.

Over in the garage we found a pair of overalled legs sticking out from beneath a truck. Between blows of his hammer were heard staccato cuss words for Peggy cussed as easily as he breathed. He did not wipe his hand on his overalls when we met; he did not wipe it at all; he smeared mine all over with grease, but I did not object for this is the way an artist should get his contact with everyday life.

"Not by a damn sight! I'm black enough!" was the reply when I told him I wanted to paint him. With that he went back under the truck and the next day there was no Peggy around the works. The second day, by appointment, he sat in the employment manager's office, twisting his old hat and wondering what was going to happen to him. I went up to him, put one hand on his shoulder and asked if he did not think it as high an honor as a man could wish that his boss should pick him out to be the first man out of some five thousand to have his portrait painted?

"What have I got to do?" he asked.

"All you have to do is sit still while I work," I replied.

"Oh, hell!" he exclaimed, "I can't sit still." It is not easy for any man who bubbles over with spirit to sit still, but he came. I sat him down on a little stepladder three steps high and there he remained, expressionless,

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*MEN ARE SQUARE*, AN OIL PAINTING EXECUTED IN THE MILLS OF THE HYDRAULIC STEEL COMPANY, CLEVELAND, OHIO, AS AN EXPRESSION OF MUTUAL FAITH AND TRUST BETWEEN EMPLOYER AND EMPLOYEE

© Gerrit A. Beneker

*THE ALABAMA KID* — ". . . THAT FELLOW HAS MORE COÖPERATIVE SPIRIT THAN ANY OTHER FELLOW AROUND HERE"

glum, a rivulet of brown trickling from the corner of his mouth, a bulge in one cheek, while I plastered paint on canvas with a pallette knife. I had worked for half an hour, establishing the relative values of flesh to background, when he exclaimed, "Hey, how long is this going to take?"

"Why, I've only just begun," I replied.

"Well," he argued, "I've got to get back and fix them trucks. They're waiting for them."

"Oh, no you don't," I parried, "I have the authority to haul any man off the job on company time long enough to paint him, providing he is willing, and you wouldn't be here if you weren't willing." He continued to sit.

After a while I reached a place where I wanted some expression in that piece of clay so I told him a funny story. He grunted. I asked him if that hurt.

"What?" he asked.

"Weren't you trying to laugh?"

Then he did laugh, and from then on he would snap on that crooked smile as you turn on an incandescent lamp whenever I asked for it. He had begun to get interested.

"Say, can I see what you are doing?" he asked.

"Sure, come on around," I replied. Here was the test. What was it going to be? In his own homely way he burst out, "Well, I'll be damned if it don't look like me!" And before I knew it he had half a dozen of his fellow men there to see this "damn thing" that looked like him. There immediately followed much pounding on broad backs and remarks such as, "Why don't you paint a handsome guy like me?" Several times a day and for several days he kept bringing his fellow men to the studio to see this "damn thing" that looked like him, and some three weeks later a four-color reproduction of the picture appeared on a publication which went to the five thousand workmen in the four plants and to the stockholders of the company. On the reverse side of the reproduction of the portrait was a little philosophy on the "black hand" and what it stands for today. One could write volumes about black-handed truck drivers and what they are contributing to the well-being of all of us, but I made it an expression of the simple, natural philosophy that grew out of the contact of the artist and his subject matter, supplementing the emotional appeal of the portrait by an intellectual explanation of its meaning.

After the magazine had been published I could not walk through any one of the four plants without being asked, "When are you going to paint me, Ben?" "Who's the next guy on the cover?" Men invited me to their homes to dinner to tell me of their problems, and very soon I was in a position to help the management see the workman's point of view and, in turn, to help the workman reason out his problems.

It was simply a matter of employing art in such a way that it spoke to these people in their own terms, in a language which they understand. It was the artist "lending his mind out" to help people interpret the meaning of many everyday objects, including themselves.

As Browning has so adequately expressed it:

"We're made so that we love
First when we see it painted, things we have passed
Perhaps a hundred times, nor cared to see;
And so they are better painted — better to us, which is the same thing.
Art was given for that. . ."

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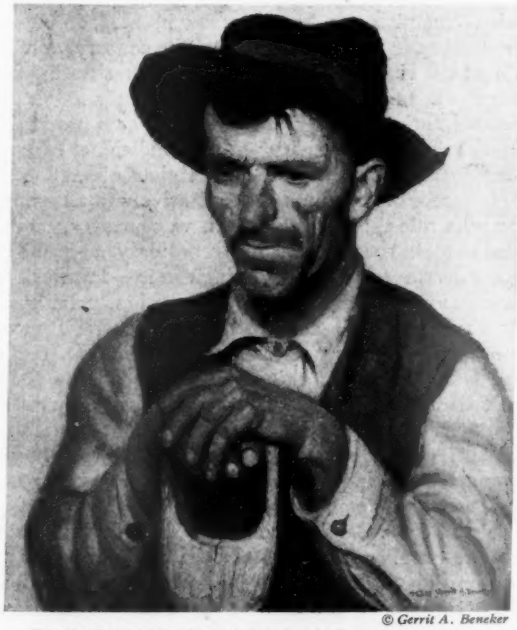
*THE INVENTOR* — "FOR FORTY-FIVE YEARS HE BENT OVER HIS BENCH INVENTING SOCKETS, INSULATORS, SWITCHES"

It is because the working people can find no art that addresses them in their own terms that our art museums fail to attract them. Instead of finding there art which "addresses him with a voice of lofty cheer" in his own language, the working man sees portraits of millionaires and ladies of fashion, to say nothing of neurotic and over-sexed objects of art which he cannot understand. The museums have not welcomed art that portrays the mainstays of human society. When Millet first sent his paintings of French peasants to Paris salons he was termed a socialist — a dangerous man to society.

SOME of the young men at the head of the company which employed Peggy Hirsch had worked out some industrial relation ideas which were proving to be sound. This was well demonstrated when an epidemic of strikes occurred all about them and only five or six men out of their total of five thousand walked out. In the height of the strife the man whose portrait is reproduced on the cover of this Review wrote to the young vice-president: "Dear Doc: No matter what happens, know that I am with you."

I wanted to see that man. Over in the sheet mill I found him, heating slabs, bringing them to the proper temperature for the roller. He wore a stubble beard to protect his face from the heat of the furnaces. As he stood before me and while I painted, we talked. "Homer," said I, "I'm going to call you a radical."

"Sure, Ben," he replied, "that's the only thing you can call me. Ask some of the boys around here and they will tell you that I used to toss pebbles through the manager's office window just to get his attention [these pebbles were bricks]." "But," he continued, "I don't have to toss pebbles through the manager's window now."



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*AN ENGINEER FROM THE SOIL* — AN EMPLOYEE OF THE GENERAL ELECTRIC COMPANY PAINTED IN 1924

© Gerrit A. Beneker

*PEGGY* — "MY HANDS ARE BLACK BUT MY HEART IS HYDRAULIC." BENEKER'S FIRST PORTRAIT IN HIS CHIMNEY STUDIO

Why? Homer had been elected by some thirty of his fellow men to be their representative. There were similar representatives elected by other groups and these men had access to the manager's office any time they wanted to see him. When the industrial depression of 1921 arrived and orders were falling off and unemployment increased, the series of strikes I mentioned above were precipitated, but not in this plant; these representatives, such as Homer, met behind closed doors and reasoned matters out together. They concluded that it was better to stay at work, if possible, and to take a cut in wages, so these "radicals" went to their manager and told him they had voted themselves a cut. As conditions grew worse they went again to see the manager and told him they had voted themselves another 10% cut. A few months later as conditions became even more serious they went to him again and said, "Boss, you go out and get the job and we will roll it for any price you can pay and make a profit."

How infinitely better and "radically" different than having absentee directors in Wall Street dictating a 20% cut in wages, leaving the workmen to find it out when they received their pay envelopes! That is what hurts; that is what makes destructive radicals. When men understand, however, they can reason matters out for themselves and they will usually do the right thing. It is a question of leadership, and it is a wise boss who will ask the man who does the job what he thinks about it. Art can help to make men understand because it contributes to the building of character. And the character of any organization is but the sum total of the individuals in it.

There are other reasons why Homer does not throw bricks. He married a school teacher. They had five children, and when I painted him 10 (*Continued on page 40*)

# INDUSTRY AND ENGINEERING IN THE UNION OF

TESTING A NEW DRILLING MACHINE IN THE "RED PROLETARIAN" MACHINE TOOL FACTORY OF MOSCOW

EDITORIAL NOTE: *Below is a record of the impressions of an American engineer made on his second professional journey to Russia. His memoranda were set down frankly as a personal record and not with a view to publication; consequently he prefers to preserve his anonymity.*

*The Review Editors or the reader need not subscribe to the politico-economic doctrines of the Soviet Régime in order to appreciate the valuable first-hand information which these memoranda contain. Since 1924 over 2000 American business houses have received Russian orders, and American exports to Russia in 1929 increased $54,000,000 over 1928. Consequently, Americans are becoming highly interested in the Soviet Union's development program. The observations in the article below are exceedingly helpful in clarifying many misconceptions about that program.*

*Moscow, January 31, 1930*

IT'S Sunday every day for somebody in Moscow! This would be quite a fetching title for a song. Since one-fifth of the Moscow population celebrates its Sunday each day of the week, the theaters and places of amusement are always crowded, as are the shops and the streets.

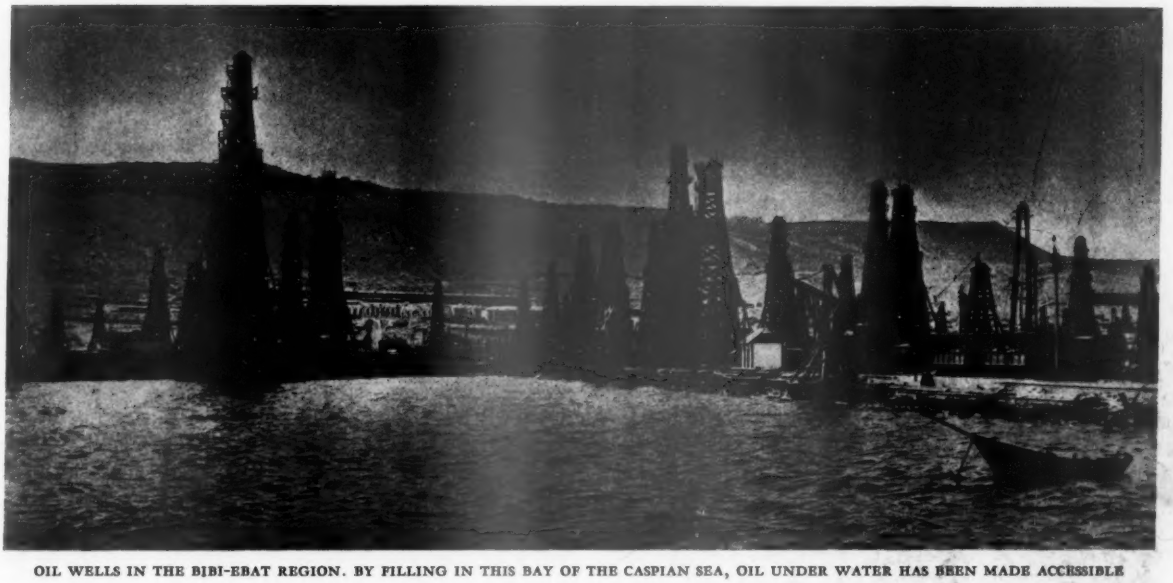
At this hotel last year there was a supper dance every Saturday night, starting after the theater and lasting until about three in the morning. On Sunday afternoons Tea Dances were given in the imposing Marble Hall. Since the new decree making every day Sunday for one-fifth of the population, teas are given daily, and supper dances every night. The orchestra is located in a gallery, a sort of bridge, between the main dining-room and the Marble Hall, and is one floor below the fourth, on which my room is located, so that I have to listen to the damn' orchestra from five p.m. every afternoon until three the following morning with occasional interruptions. They probably have two or three shifts of orchestra men, for no one can keep up blowing a trombone or scraping a violin for ten hours straight. It's mostly jazz, and I am fed up on it. Am still waiting for a room on a lower floor at the other end of the hotel, to get away from this maddening music. The manager told me that the supper dances are crowded every night, so Moscow is not all in tears as some of our friends at home would have us believe.

The reason for adopting the five-day week, four days of work and the fifth for rest, was purely economic. The demand for products of all kinds for this rapidly growing nation has been so great and so insistent that the available plant capacity proved entirely inadequate. To bring their plant capacity up to their demands would have taken time and required an expenditure of approximately two billion dollars, a sum of money which the government could not raise in addition to the vast expenditures for which commitments have already been made. It was found that the industrial plants of the country were idle 25% of the time, while the employees were resting from their work, and they estimated that if the plants could be operated during this period they would gain proportionally in productive capacity without additional expense.

Since traditions, customs, and religious observances do not influence the decisions of the relatively small group of men who rule the destinies of this vast country, they decided to make the experiment. Accordingly, a few months ago, a decree was issued ordering the five-day week and the continuous operation not only of industrial plants, but likewise of all administrative offices and general stores. Some confusion was at first inevitable, but the plan is apparently working smoothly, and the people, with their habitual docility, have adjusted themselves promptly to the new order of things, and the slight difficulties have been ironed out. The difficulty of holding committee meetings, of which they are especially fond, was particularly embarrassing. As one of the officials put it to me, "Four days of the week we are looking for the other fellows, and on the fifth they are looking for us." But the difficulty has been overcome by having men in key positions, whose presence at the same conferences is necessary, take the same day off, and by restricting important conferences to certain days.

By An American Engineer

# SOCIALIST SOVIET REPUBLICS



OIL WELLS IN THE BIBI-EBAT REGION. BY FILLING IN THIS BAY OF THE CASPIAN SEA, OIL UNDER WATER HAS BEEN MADE ACCESSIBLE

At first thought it would appear that four days for work and a fifth for rest would reduce the total working days during the year. Actually it does not. Under the old régime there were 52 Sundays, some 30 church or civic holidays, and often a paid vacation of 12 working days, making a total of 94 days. Now there are 72 days of rest per year, five holidays, and 12 vacation days, a total of 89.

Although this plan has been in operation only a few months, an appreciable increase in production is already indicated. Whether the plan will also increase the production per man remains to be seen. Collateral advantages claimed for the five-day week are that places of amusement are not so crowded as formerly, that distribution of merchandise is more efficient and cheaper, and some also claim that it has decreased the consumption of liquor, since the days of rest are usually staggered among members of a family, thereby having a restraining effect.

Of course, there has been opposition from the clergy, because this plan tends to diminish the importance of Sunday as a day of prayer; but, on the other hand, churches are now conducting services every day. As soon as the government had decided on the five-day week, pamphlets were published and lectures broadcast over the radio explaining the economic advantages of the reform. An experiment of this kind would be practically impossible in any other country but Russia.

*Moscow, February 1, 1930.*

I bought three tickets for the opera yesterday, first row at four dollars each. H—— was detained and so I turned in one of my tickets; half a dozen people were ready to take it off my hands. The lucky fellow was a young man of 23, in a dark flannel shirt, without coat or vest. He had just arrived from Yaroslavle, a celebrated city on the Volga, where he is an instructor at a college. It was his first trip to Moscow, and he had been sent by his college to obtain permission from the High Commission of Education to give correspondence courses to those who were unable to attend their institution in person. It must have been quite a sacrifice for him to pay four dollars for a seat at the opera; but a Russian would rather see a good play or listen to a fine opera than to eat or sleep.

The audience looked notably trimmer than last year. The women wore silk scarfs and other fineries, looked better groomed, and even the men looked as if they had tried to shave, occasionally one saw even a white collar. I shouldn't be surprised if in a few more years a man or woman would feel quite out of place at the opera when dressed in a sweater or flannel shirt and high boots. But, regardless of dress, the audience was certainly appreciative of good music and acting; the applause was loud, and the curtain calls persistent. I have already been at two operas and one ballet, and each time the house was crowded to capacity.

It is getting colder every day, about 15 degrees below zero at night, and not warmer than six below all day. If it keeps on, we shall soon be having as cold weather as we had while I was here last year. I hope not.

I was at the Grain Export headquarters this morning, and learned that Russia is now exporting grain again, and preparations are being made for increasing these exports. Russia is bound to become again the great grain exporting country it used to be; with this difference, however, that

LOCOMOTIVE ASSEMBLING SECTION OF THE KOLOMENSKY WORKS OF THE "GOMZA TRUST" — A STATE COMBINE

hereafter no grain will be exported until ample provision has been made for the entire population, which was not the case in pre-revolutionary days. Of the abundant crops of last year 36 million poods have been set up as a reserve against emergencies, and this reserve is to be tapped only in the event of urgent national need, such as famine or war. This wise precautionary measure is the result of their sad experience during the famine of 1921, and of their close call last year. In spite of the severe drought over the entire agricultural belt of the south during the summer of 1928 their exportations of wheat last year indicated much larger amounts. It is easy to get misinformation here, and that may account in part for the inaccuracies published so often in our papers; but figures obtained from the men in responsible positions are invariably correct.

*February 10, 1930*

Yesterday I gave W—— the experience of a ride in a street car. By the time we reached our destination he was sure every button of his overcoat was off. Late in the forenoon or the afternoon it is almost impossible to find a taxi, and as it is too cold to walk for any length of time, a street car is the only alternative. The crowded condition of these trams reminds one of the subway at home. The windows are usually heavily frosted on the inside, and the people breathe on the window panes to thaw out a space large enough to enable them to keep their bearings, since conductors do not call out streets or stations. Here cars do not stop at every corner, but at definite stations several blocks apart.

Today I investigated the street back of the hotel, where there are long rows of shops and markets of all kinds. The queues of women outside these stores were long, as many as a hundred in some of them, waiting patiently to get into the government or co-operative shops to buy their food supplies. To the casual observer the waiting crowds might indicate a lack of food, and this conclusion is often drawn; but the reason is merely very bad management. I watched the crowds for a while, and then, to get a better idea of just how poor the service was, I went in to make a purchase. It took me just half an hour to buy a pound of caviar for two dollars. First I had to find out the cost of the caviar that I wanted; then I had to stand in line behind some thirty women to get a check for four rubles and 20 kopecks; then I had to stand in line at the counter where I could exchange my check for some caviar; but my can was overweight, and I needed another check, and had to go through the same performance again. The whole scheme is as inefficient, stupid, and slow as is possible to imagine; too much regulation and too little service for the number of customers. The Soviets have made excellent progress in their industries and are carrying out gigantic reforms in agriculture, but their system of retail distribution is simply disgraceful.

On top of this, the private trader is gradually and surely being crowded out. Shops that I visited a year ago have disappeared entirely. There could be no quarrel with this, if the government provided proper facilities in their own stores, but everywhere and always you see the same crowds, the same tedious waiting. Bargaining and exploitation have been done away with, but the inadequate methods of distribution are almost as great an evil. I suppose it will be corrected in time, and meanwhile only a patient and long suffering people like the Russians will endure it with a smile.

Their homes are crowded beyond our comprehension, because of a housing shortage; their shops are crowded; street cars and railway trains make our subway in rush hours seem leisurely and comfortable; their stations and narrow sidewalks are packed. They have just been trying to regulate pedestrian traffic, and in their effort to relieve the congestion they ordered the crowd to proceed in one direction on one side of the street and in the other direction on the opposite side. A large number of special police in civilian clothes, but with red bands on their arms, were stationed at every corner to direct the traffic and to prevent jaywalking, and large placards were posted everywhere appealing to the citizens not to crowd, and to

move in one direction only. After a three-days trial the experiment was given up; it is hard to make a man walk where he doesn't want to go.

When they get more automobiles they will need a light signal system, but that is some time off yet. Plans have been worked out for a Greater Moscow, opening up the surrounding country and widening the streets; but that will have to wait for more important problems.

*February 14, 1930*

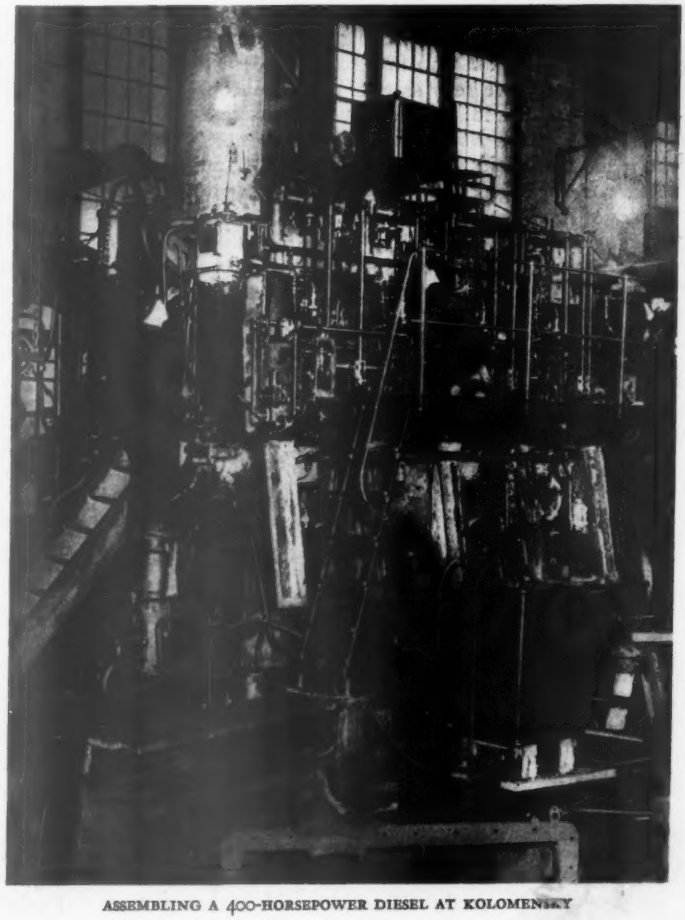
At present there is quite a stir over the news that Russian engineers, of whom there are probably 100,000, are to be invited to join the Communist party. Heretofore, the powers that be have rather frowned on having intellectuals and professional men in the "Proletarian" Party, in which a very rigid discipline is maintained, and so there is much speculation concerning the reason for this move. The most probable explanation is that the Party now feels so thoroughly intrenched that it can with safety admit to its ranks a group of men who during recent years have played an important rôle in the industrial regeneration of the country, but who have remained politically aloof. To admit them at present would obviously be good politics, and would strengthen the organization as well as remove a potential nucleus of organized opposition. Whatever the motive, it is an interesting political development that may have far-reaching consequences. It may eventually mean a more conservative trend, and the complete abandonment of the policy, which so far has proven a failure, of proselytizing the world to Communism. It will be interesting to see how many accept the invitation.

Engineers, for whom there is a great demand that will continue for some time to come, occupy a preferential position in the proletarian government, and command compensation commensurate with their services. If they join the Party, they will not only be subject to party discipline, but their compensation will be fixed at the maximum allowed a communist, which I understand has been increased to 300 rubles a month from the 225 of last year. Many engineers are now getting as high as 500 to 1,000 rubles a month. It will, therefore, be necessary to adjust this difference, if the Party hopes to attract engineers and members of other professions.

Another objection to party membership is that a member is subject to the orders of the Party Council, and must go wherever he may be sent, and where in the judgment of the Party he is needed most. It is like joining the army and being at the beck and call of Headquarters without power of protest. So far it has been the policy of the Party to shift its key men from place to place. Often men are taken from the ranks and put into executive positions and after a few years of such service put back into the ranks again. We started negotiations here with Mr. V——, who was in charge of the railway repair shops. Almost without notice he was transferred to the interior on some important railroad job, and a new man took his place, and we started all over again. This imposes hardships, and may temporarily affect the continuity of a policy, but on the other hand, it reduces the probability of a man's becoming stale on the job, a danger that is particularly great here where they are suffering from the worst case of bureaucracy that I know of. Perhaps this is one way of breaking up the evil.

*February 26, 1930*

One of the unfortunate effects of their long years of struggle is that the leaders of the Russian Dictatorship have lost faith in everyone except the 100% communist. They believe that all who are not with them are against them, and are not to be trusted. Apparently they will not admit that there can be honest difference of opinion, or that people can disagree with them and yet follow with interest and sympathy their efforts to work out their own salvation in their own way. They themselves are passing through a materialistic phase of development, and lose sight of the fact that in Western Europe and in America the motivating force of action is more often based upon high principles and accepted standards of morality than on material considerations alone. This is very evident in business discussions. Paradoxical as it may seem, many of the leaders, while subjecting themselves to untold sacrifices for an ideal, scoff when an outsider would place morality and character (*Continued on page 44*)



ASSEMBLING A 400-HORSEPOWER DIESEL AT KOLOMENSKY

# SAVING COAL BY SCIENCE

## *The International Agreement on the Properties of Steam Reached at the Second World Power Conference, Berlin, 1930*

By Frederick G. Keyes

THE SCIENCE of the generation of steam and its subsequent use to produce power would have appeared a dozen years ago to have reached a stage where only minor and insignificant improvements were needed or desirable. The designers of steam-operated prime movers and steam-generating apparatus have not been content, however, to recognize any such stage. On the contrary, they have quite boldly explored the possibilities of design which would increase the efficiency of steam power generation. Thus in ten years the coal per kilowatt hour (k.w.h.) has been reduced in central stations from about 3.2 lbs. in 1919 to 1.84 lbs. in 1928, and 1.65 lbs. in 1929. When it is recalled that 46,000,000 tons of coal were used in central stations in 1929, the enormous economic importance of what has happened is apparent. What are the factors which have entered to bring about such a striking result?

The answer, as in other matters, is not entirely simple, but the surprising progress realized is to a considerable degree dependent on, and connected with, a more accurate and extensive knowledge of the physical properties of the working fluid, steam. The coöperative effort between engineers and scientific men, which has provided the required additional knowledge of steam properties, forms for the engineer one of the most interesting examples of the fundamental importance of pure science to the progress of applied science.

### *World Power Conference*

THE recent "Steam Properties" conference in Berlin on the occasion of the Second World Power Conference completed the review and discussion of new experimental data which was begun at the London Steam Conference in 1929. The World Power Conference itself has been already well reported in two articles in *Power*, to be found in the June 24 and July 1 issues. This latter conference, of great importance to the engineering profession, convened in Berlin on June 16 for its second plenary session and was attended by more than 4,000. Without doubt it was the greatest engineering gathering of world-wide scope ever held. The meeting brought together the leaders in science and engineering as well as important personages in education, industry, finance, and government.

The first plenary session of the World Power Conference was held in London in 1924 and occupied itself mainly with discussions of machines and engineering developments. The recent second Conference took as its central theme economics as bearing on the problems of distribution and utilization of power. On these subjects some 400 papers were contributed by the engineers and economists representing 47 nations. Of further general interest is the fact that four days before the general session convened Mr. O. C. Merrill, Chairman of the American Committee, invited the Conference to hold its third plenary meeting in the United States in 1936 and the invitation was accepted.

Sunday, June 15, there took place a special meeting at which Mr. Oskar von Mueller was inaugurated as new President of the Conference succeeding Lord Derby. This was followed in the evening by a reception at the Reichstag Building where the delegates were welcomed by Mr. von Kardoff, Vice-President of the Reichstag. Monday morning, June 16, the first general session took place in a setting made brilliant by the flags of all nations, and the meeting opened by an address by Mr. von Mueller. The Reich Chancellor, Mr. Bruening, read a message from President von Hindenberg.

The afternoon session was opened by an address by Professor Albert Einstein, who gave a very elegant exposition of his theory of space and time. Wednesday afternoon during the American Hour, the American Ambassador created a mild furor by referring to the price spread between bus-bar cost of electricity and the retail cost in America. One statement of this address declared, "I know of no other manufacturing industry where the sales price of a product to the great mass of consumers is fifteen times the actual cost of producing the article sold. My purpose is sharply to define a weakness that calls for the keenest thought in your deliberations." Needless to say, this statement aroused vigorous protest and discussion.

### *The "Steam" Conference*

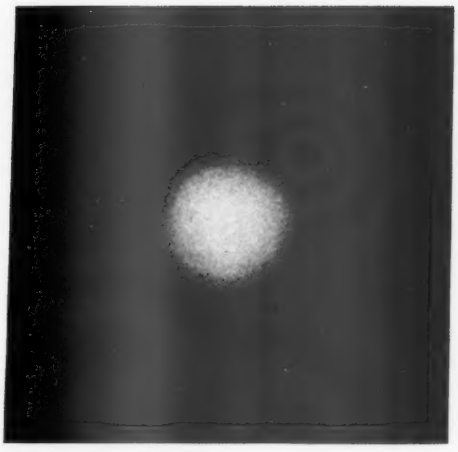
IT IS perhaps well to recall that the International Conference on Steam Properties is the outcome of a program of research initialed at a meeting held in Cambridge on June 23, 1921. There gathered on this day a group of scientists and engineers who discussed in detail the limitations of machine design imposed by the lack of sufficiently accurate and extensive steam data. There was accordingly laid out a comprehensive program of research to be sponsored by the American Society of Mechanical Engineers. Funds were to be raised by a sub-committee of the A. S. M. E. Research Committee.

Briefly the program of steam research decided upon was to be carried out in three parts as follows:

1. Joule-Thomson cooling effect in charge of Dr. Harvey N. Davis, at the Harvard Engineering School.

2. The Specific Heat of Water, Heat of Evaporation and Mechanical Equivalent of Heat, in charge of Dr. Nathan S. Osborn at the U. S. Bureau of Standards.

3. The Pressure-Volume-Temperature Relations to the highest possible temperatures in charge of Professor Frederick G. Keyes at Technology. (*Concluded on page 54*)



"APPEARANCE" OF A HELIUM ATOM

BASED ON HEISENBERG'S THEORY (LANGER)

# LOOKING INSIDE THE ATOM

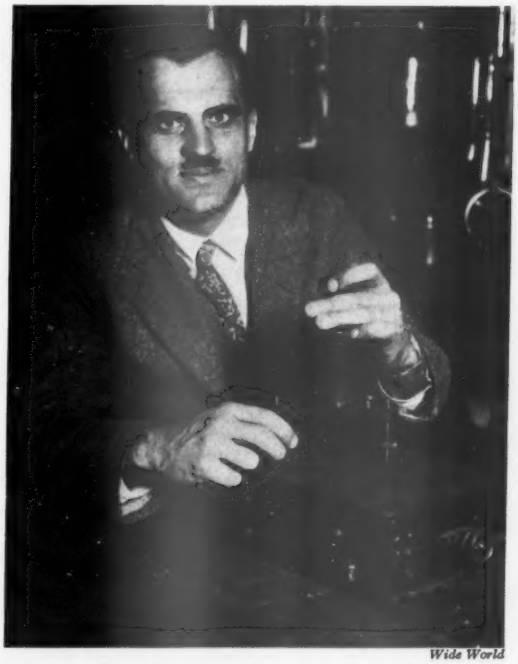
## *X-ray Scattering and the Structure of Atoms*

By Arthur H. Compton

SEVERAL weeks ago I noticed a beautiful ring, or corona, as the meteorologist would say, around the moon. Half an hour later the corona was visibly smaller in diameter, and it was no surprise when a few hours later rain began to fall.

The interpretation of such coronas, as due to the diffraction of the moonlight by droplets of water suspended in the air, is well known. The larger the droplet the smaller the angle of diffraction necessary for the appropriate phase difference between the rays coming from the two sides of the drop. So by observing the diameter of the ring, we can estimate the size of the water drops which cause it. A shrinking corona means a growing drop, and hence probable rain.

In a very similar manner it is possible to find the size of molecules and atoms in a gas, by observing the diffraction halos produced when they are traversed by a beam of x-rays. For many years it has been possible by this method to make rough estimates of the sizes of the atoms; but only very recently has the theory of the process become well understood, and the experimental technique become sufficiently developed to give us precise information regarding electron distributions.



*Wide World*

THE AUTHOR AT HIS X-RAY SPECTROMETER

When we review the many atomic theories that have been proposed and discarded, it may perhaps appear too bold to say that the particular theory now in vogue has any finality. One by one the vortex ring atom of Kelvin, the positively charged jelly of Thomson, the minute solar systems of Rutherford, Bohr and Sommerfeld, as well as the tiny atoms of Crehore, the ring electron atoms of Parson, and the cubic atom of Lewis and Langmuir have given way to more promising successors. We replace even Schrödinger's diffuse cloud of negative electricity by a probability cloud of electrons after the manner of Heisenberg. It now appears however that the only one of these many proposals which can account for the observed x-ray diffraction halos is that of Heisenberg.

### *History of the Diffraction of X-rays by Atoms*

IT was as early as 1911 that experiments by Owen[1] and Crowther[2] revealed a strong "excess" scattering of x-rays at small angles. D. L. Webster[3] seems to have been the first to ascribe this phenomenon to interference between the rays scattered by electrons closely grouped together. This idea was developed

extensively by C. G. Darwin[4] in his theory of the diffraction of x-rays by crystals, in order to account for the relatively high intensity of the low orders of x-ray reflection. A year or two later Debye[5] developed in similar detail the theory of the diffraction of x-rays by amorphous materials, in which each atom could be considered to act independently of the others.

Thus there were presented two methods for studying the diffraction of x-rays. The first is by crystals, in which after taking into account the interference occurring between the various atoms in the space lattice there emerges the diffraction pattern due to the atom itself. The second is a study of the scattering of x-rays by amorphous substances, in which we are really limited to the scattering by gases, since only in this case can we neglect the effect of interference by neighboring atoms.

## *Intensity of Reflection of X-rays by Crystals*

DUE in part to the very low intensity of the x-rays scattered from gases, and in part to the rapid development of the study of x-ray reflection by crystals in the hands of the Braggs and others, it was the crystalline diffraction problem which first received extensive experimental study. In these early studies, before the war, Sir William Bragg and I working independently[6] were able to make sufficiently accurate estimates of electron distances within atoms to rule out as unsatisfactory Crehore's atomic theory and Bohr's first theory of the heavier atoms. An unforeseen difficulty appeared,[7] however, in the form of the rapid extinction of the x-rays as they enter a crystal at the angle of maximum reflection. It was impossible to calculate this extinction for a real crystal, and the early attempts to measure it were unsuccessful.

Following the war, however, W. L. Bragg, working with James and Bosanquet,[8] developed an approximate method of correcting for this extinction. Sir William Bragg[9] went one step further, when he showed that it was feasible to make ionization measurements of the x-rays diffracted by a crystal powder, in which the extinction was negligible. This powder method has since been applied extensively by investigators at Chicago and Harvard.

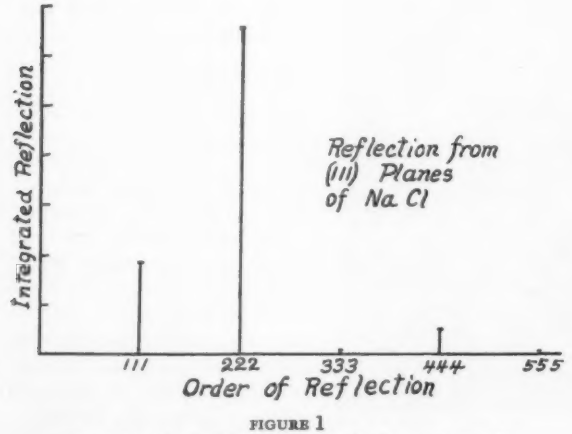



FIGURE 1
*Intensities of reflection from the (111) planes of rock salt*

A great step in advance was made when in 1925 Duane[10] showed that density of electron distribution could be expressed as a Fourier series, each term of which was determined by the intensity of the corresponding order of x-ray reflection. With the help of this theorem it is now possible to translate x-ray intensity measurements directly into electron distributions.

Consider for example the reflections from the (111) planes of rock salt, as shown in Figure 1. Using Duane's formulas, each of these intensities determines the amplitude of the corresponding harmonic in the Fourier series representing the electron distribution, as shown in Figure 2.

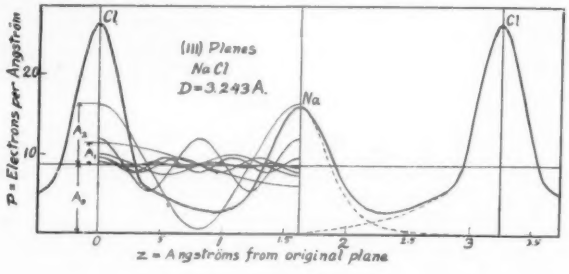



FIGURE 2
*Density of electron distribution in layers parallel to the (111) planes of rock salt*

This method of analysis shows directly the alternate layers of sodium and chlorine, as well as the diffuseness of the atomic layers themselves.

An extension of this analysis[11] enables us to use the same data to write a Fourier series representing the radial distribution of the electrons in the atoms of a crystal. Such a curve representing the sodium atom in rock salt, as analyzed from the data of Bragg, James and Bosanquet, is shown in Figure 3. Similar curves have been obtained for a large number of the lighter atoms.

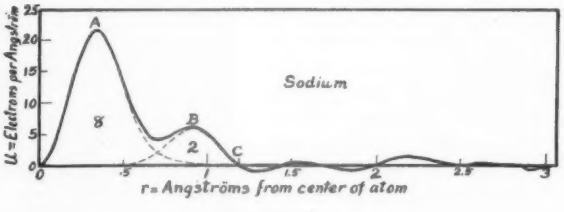



FIGURE 3
*Radial distribution of electrons in the sodium ion of rock salt*

There are several points of interest in curves such as this. In the first place it will be seen that the diameter of the atom, about 2A, is of the same order of magnitude as the distance between atomic centers. This is in accord with the dimensions as ascribed by the Bohr-Sommerfeld and the new quantum mechanics theories of the atom. It will be noted, however, that the distribution found in these experiments is continuous, and not divided into sharply defined shells as was predicted by Bohr's theory. In fact, as early as 1922 Bragg, James, and Bosanquet concluded from these studies that it was doubtful whether it was possible to account satisfactorily for the observed intensities by any other than a continuous dis-

tribution of the electrons. This was a bold statement in the days when Bohr's theory was considered to be "the law and the prophets".

There is however some apparent diffuseness resulting from the thermal agitation of the atoms within the crystal lattice. Unfortunately we have no means of knowing the exact amplitude of this thermal motion, and until we do so it is impossible to interpret curves of the type of Figure 3 in terms of electron distributions around a stationary nucleus. The difficulty is that of knowing whether there is any motion remaining at the absolute zero of temperature, which if it exists must affect our interpretation very considerably.

## *Scattering of X-rays by Gases*

TURNING now to the diffraction of x-rays by gases, it is clear that the thermal motion is of no consequence. For in this case each atom is scattering independently of the others, since the phase differences between the different atoms is random. Also there is no extinction problem to bother us. From measurements of the diffraction of x-rays by gases it should thus be possible to get more complete and reliable information regarding electron distributions than from the diffraction by crystals.

Here however there are also difficulties. There is the obvious one of intensity; for the work must be done with homogeneous x-rays, and homogeneous x-rays are weak. Moreover gases scatter only feebly, and at best scattered x-rays are not strong. Nevertheless, thanks to the gradual development of sources of x-rays and of methods of measurement, this experimental difficulty has to a large extent been overcome.

A more serious obstacle arose when it was found that the scattered x-rays were not of the same wave-length as the primary rays. This was a departure of fundamental importance from the diffraction theory that was being used to explain the phenomenon. For according to this theory the effect sought for was the interference between rays scattered by neighboring electrons, whereas the interpretation of the change of wave-length of the scattered x-rays was based on the assumption that an x-ray was scattered by only one electron at a time. This difficulty does not appear in connection with diffraction by crystals, for in this case the diffracted and the incident ray are of the same wave-length. It was necessary therefore to postpone the interpretation of these scattering experiments until the diffraction theory was extended to include the phenomenon of the change of wave-length. During the past two or three years this has been accomplished by Wentzel and Waller. Their results indicate that to a close approximation the calculations of the classical diffraction theory are valid, and an approximate correction term can be simply applied to make the diffraction theory still more reliable.

Using such a corrected formula, mathematical analysis again makes possible the expression of the electron distribution in terms of the observed intensity of the scattered x-rays. In this case the formula obtained [12] is the Fourier integral

$$u(r) = r\int_0^\infty B \sin\left(\pi r x\right) dx \qquad (2)$$

where $x = 4/\lambda \sin \varphi/2$, and $B$ is a quantity determined by the intensity of the rays scattered for any particular value of $x$.

Thus in the case of helium, the data of Figure 4 show the intensities of the scattered rays as measured by Barrett.[13] When put through the Fourier mill, from these

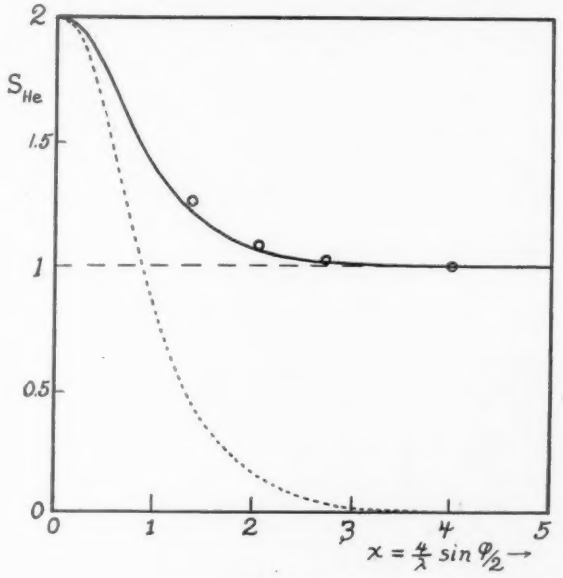



FIGURE 4

*Intensity of x-rays scattered by helium for different values of x. Data from Barrett's experiments; solid line from Heisenberg atom; dotted line from Schrödinger atom*

data is ground out the electron distribution in the helium atom shown by the solid curve of Figure 5. We note a maximum of electron density at about 0.32A, which

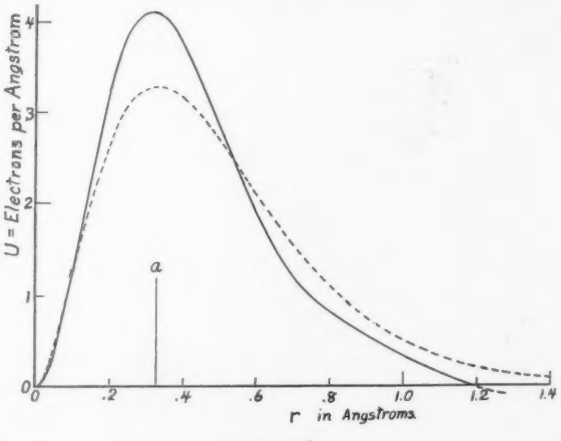



FIGURE 5

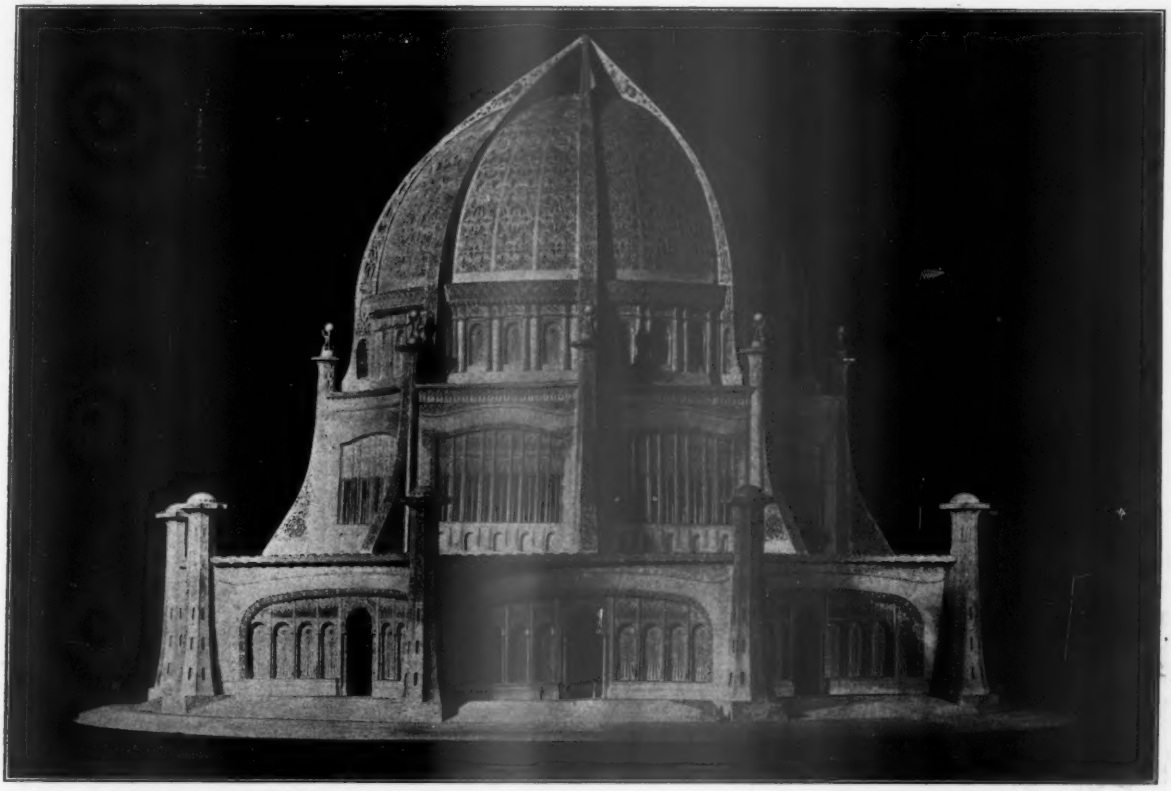
*Radial distribution of electrons in atom of helium. Solid curve calculated from Barrett's experiments; broken line, Heisenberg-Schrödinger theory*

is very near the radius of the electron orbits of helium calculated on Bohr's theory. The distribution is however definitely diffuse, instead of being strongly concentrated

(*Continued on page 50*)

*Photograph of Irving Trust Company Building, by Ewing Galloway*

*THE CONSCIOUS STONE TO BEAUTY GREW"*



ARCHITECT'S MODEL OF BAHA'I TEMPLE

# A TEMPLE OF LIGHT

## *"The First New Idea in Architecture Since the Thirteenth Century"*

By Allen B. McDaniel

ERECTION of the long projected Baha'i Temple, unique in its architectural and engineering design, is to be begun this autumn in Wilmette, Ill. Since so much about the Temple is structurally new and arresting, it seems appropriate to present a description of it, especially those features of interest to architects and engineers.

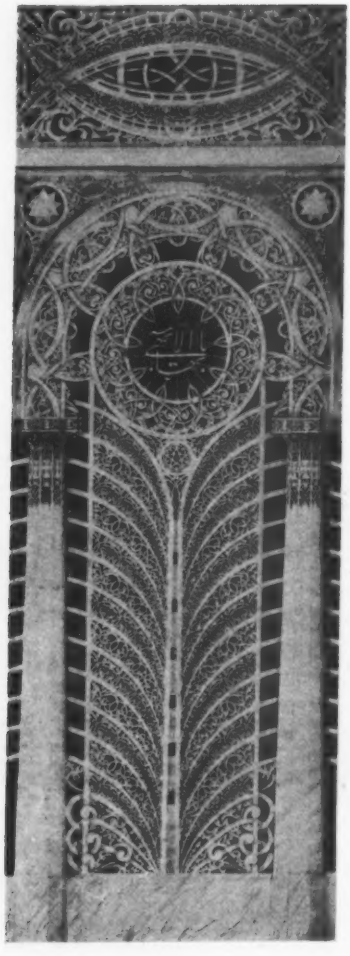
Architecturally, the Temple is a unique, original form — "the first new idea in architecture since the Thirteenth Century" according to Mr. H. Van Buren Magonigle, architect of New York City. Mr. Magonigle has given the following description of the Temple:

"Mr. Bourgeois has conceived a Temple of Light in which structure as usually understood is to be concealed, visible support eliminated as far as possible, and the whole fabric to take on the airy substance of a dream; it is a lacy envelope enshrining an idea, the idea of Light, a shelter of cobweb interposed between earth and sky, struck through and through with Light — Light which shall partly consume the forms and make it a thing of faery."

Structurally, the Temple is remarkable in that it will comprise a steel, reinforced concrete and glass framework, on which will be placed the highly ornamental surface material. It is a nonagon, or nine-sided structure; each side having the form of a circular arc, with a large doorway in the center; and the whole edifice giving the appearance of extending welcoming arms to the approaching people from every direction. Pylons 45 feet in height stand like sentinels at the corners of the first story. Above the gallery, the clerestory and the dome

*Chicago Aerial Survey Co.*

SITE OF TEMPLE IN WILMETTE, ILL. THE CIRCULAR FOUNDATION IS VISIBLE



are also nine-sided but with the ribs rising from midway of the first story sides.

To get a mental picture of the Temple, imagine a lofty cylindrical room topped with a hemispherical dome of 75 feet interior diameter and extending to a height of 135 feet in the center, formed of glass supported in a metal framework. The glass roof and sides protect the interior of the building from the weather. When completed, the glass will be concealed within the exterior and interior surface ornamental material, which will act as perforated screens through which the light will pass.

The weight of the structure and the dome is carried principally at nine points equally distant from the center, and the superstructure is supported on a circular platform or foundation, 202 feet in diameter at the ground surface, and rising by 18 concentric steps to the main floor of the Temple, which is 153 feet in diameter. See illustrations on preceding page.

Entering any one of the nine doors, one will pass through a hallway into the central circular room or auditorium. Out of this main hall open radially (and separated by the hallways) nine smaller rooms, comparable to chapels in a cathedral. Looking upward toward the dome, will be seen a gallery 36 feet above the main floor, and above this a second (or singers') gallery 61 feet above the floor level. Above the second gallery is a 19 foot clerestory from which springs the dome. The galleries project 10 feet into the central hall, giving the latter a clear interior diameter of 75 feet. The dome will be in three parts; the outer dome of perforated concrete or metal, the concealed wire glass weather-proof dome, and the inner dome of perforated material, decorative in character. The central domed hall will have an area of about 4,000 square feet and seat about 700 people. The nine small rooms opening out of the main hall are about 20 feet wide, 24 feet deep and with ceilings 33 feet high. These auxiliary rooms will seat about 100 persons each.

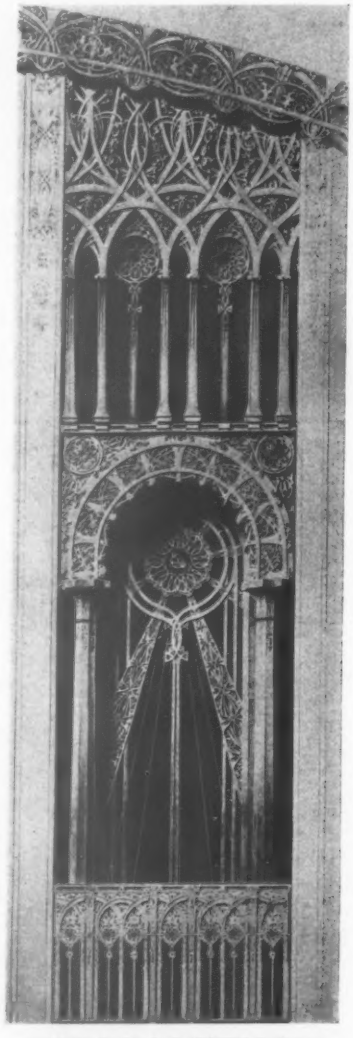
TO interpret further its architectural features let me present additional comments from an article in the *Architectural Record* of June, 1920:

"The first story in its simplicity of line suggests the Greek and Egyptian temples; while the treatment of the doors and windows is Romanesque in form, and both Gothic and Arabic in the intricacy and beauty of ornamentation. The second story is Renaissance in line and Gothic in the interlaced arches of its openings. The third is restful, quiet and Renaissance in treatment. Above it rises a lovely dome, suggestive of Byzantine forms; but above the closed top rise other beams of the dome itself like hands clasped in prayer, so that the dome gives the feeling of ascension and aspiration found previously in the Gothic towers alone.

"In the geometric forms of the ornamentation covering the columns and surrounding windows and doors of the temple, one deciphers all the religious symbols of the world. Here are the swastika cross, the circle, the triangle, the double triangle or six pointed star (or Solomon's seal, the magic symbol of necromancers of old); but more than this the noble symbol of the spiritual Orb, or Sun behind the Saviour of mankind; the five pointed star, representing the man saviour — Christ or Buddha or Mohammed; the Greek Cross, the Roman or Christian Cross; and, supreme above all, the wonderful nine pointed star, figured in the structure of the temple itself, and appearing again and again in its ornamentation, as significant of the Spiritual Glory in the world today.

"The nine pointed star reappears in the formation of the windows and doors, which are all topped by this magnificent allegory of spiritual glory, from which extend gilded rays covering the lower surfaces, and illustrating, in this

(*Continued on page 46*)



ON THIS PAGE ARE SHOWN DESIGNS FOR TWO PANELS

# THE TREND OF AFFAIRS

## *The Plastic Age*

ABOVE the economic horizon a new industry, the manufacture of plastics, is climbing into prominence. Dr. Wilson Compton, Executive Secretary of the National Lumber Manufacturers Association, declares that the aggregate value of plastic products in the United States is already equivalent to one-tenth that of the products of the lumber and wood-working industries combined, and the editors of *Plastics* assert that the volume of the plastics business has practically doubled every year, bringing its total this year up to one-quarter of a billion dollars.

What are plastics and how are they used? The material of which phonograph records are made is a commonly known product that falls into the plastic classification and, of course, there is celluloid. The first is known chemically as a shellac base plastic and the second as a cellulose nitrate plastic, but both of these are old stories. It is the discovery and spectacular development of the phenol formaldehyde resins such as Bakelite that has created an industry that approaches the magnitude of the lumber business and bids fair to challenge the supremacy of many others.

One large firm, for example, is offering for the first time "Beetle" ware, a type of tableware that is thin, light, and colorful, that will not scratch or chip or break under ordinary usage. Surely a boon to hotels and housewives!

Amemya

THE MOUNT HOPE BRIDGE OVER NARRAGANSETT BAY, BETWEEN PROVIDENCE AND NEWPORT, R. I., THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION HAS CHOSEN IT AS THE MOST BEAUTIFUL BRIDGE COMPLETED IN 1929

This is only one of a hundred varieties of new plastics: there are others that are moulded or pressed into buttons, radio dials, unbreakable storage battery jars, handles, wall panelling, and table tops. Some of the plastics can take the most delicate and exquisite color shadings; others can be made translucent or opaque. They can be extruded in the form of sheets or rods, softened by immersion in oil and then moulded into simple forms. Some of them are so hard they have to be machined.

Modern interior decorators are beginning to use the different forms for all manner of decorative purposes. Lustrous sheets of Bakelite in subtle hues are employed for walls. Lights, screened by bars of amber-hued casein plastic rods, give new effects in illumination. Furniture of chromium metal smartly set off by black Bakelite trimmings is designed in many forms.

Plastic materials may be divided into six groups, according to their method of formation:

I. *Natural gum, wax, shellac, and asphalt compounds.* Manufactured with or without drying oils in combination with inert fillers such as wood flour, asbestos, clays. Examples: PHONOGRAPH RECORDS, BATTERY JARS.

II. *Casein Plastics.* Casein, a by-product of the milk industry, when treated with formaldehyde forms a horn-like substance, capable of taking an excellent polish, of being softened by oil and moulded. It is non-inflammable and can be made with beautifully mottled effects.

Examples: PENCILS, JEWELRY, TRANSLUCENT MATERIALS.

III. *Albumen Plastics.* Resemble the casein products, although more easily moulded and dyed.

IV. *Cellulose Base Plastics.* Derived from nitro-cellulose or pyroxylin. Non-heat resistant, flexible, used as a sandwich material between layers of glass in the manufacture of safety glass.

Examples: TOILET ARTICLES, PHOTOGRAPHIC FILMS, AUTOMOBILE CURTAINS.

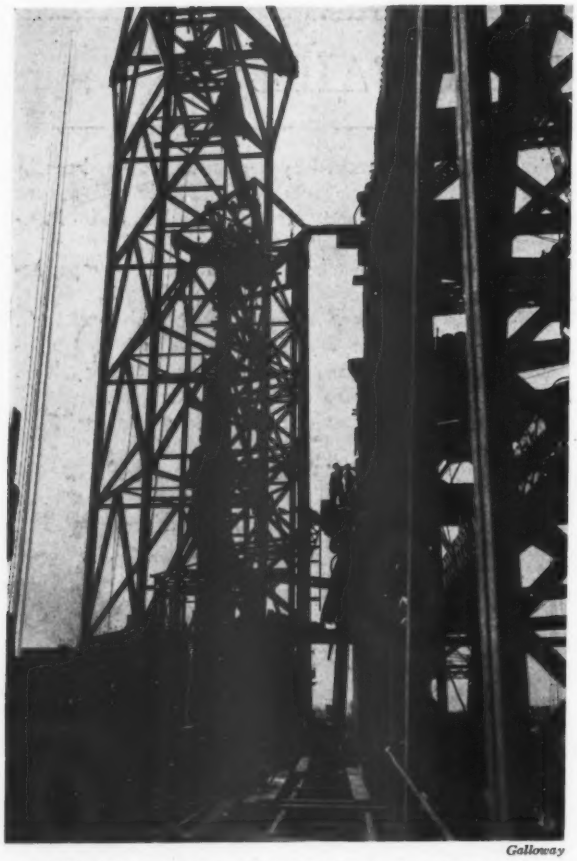
V. *Cellulose Acetate Plastics.* Closely related to IV, except that they are non-inflammable. Because of their lack of plasticity, used largely in sheet form.

Examples: SAFETY FILMS, CELLOPHANE.

VI. *Synthetic Resins.* The most important are the phenolic resins such as Bakelite and the newer materials of the urea-formaldehyde type (Beetle, for example). Extremely plastic in the formative period, these products have great strength, and high insulating qualities.

Examples: ELECTRICAL INSULATORS, RADIO DIALS.

In the *Industrial Bulletin* of Arthur D. Little, Inc., the field covered by the term "plasters" is delimited by the statement "the longer known plastic materials are not generally included when speaking of the plastics industry. The important materials . . . are those natural and synthetic resins and cellulose ethers and esters (cellulose



*Galloway*

IN THE MIDDLE AGES A RELIGIOUS ORDER OF PONTIFFS BUILT AND MAINTAINED BRIDGES. HERE ARE MODERN PONTIFICES AT WORK ON THE HACKENSACK RIVER BRIDGE

nitrate and cellulose acetate are the best known of the ethers) which may be caused to assume a definite shape either by a chemical reaction or by the influence of heat and pressure in a metal mould."

While this definition of the plastics does not include hard rubber, that substance is, of course, used in much the same manner as are many of the plastics proper. It is interesting to note that Edward W. Washburn, '05, the Chief Chemist of the Bureau of Standards has lately produced crystalline rubber from petroleum and, while chemists at the Bureau have not yet passed a final opinion on its value, they are hopeful that it will lead to a new and commercially practical source of rubber.

## *Architectural Appreciation*

JAMES RUSSELL LOWELL once declared that the Old South Meeting House in Boston was devoid of artistic or aesthetic interest, worthy of preservation only because of its historical associations. It was not comparable, he said, with the hall within which he was speaking — Memorial Hall at Harvard!

This is a fair sample of the architectural taste that is sometimes to be found in America. Of course the Old South Meeting House is incomparably finer than that crude Victorian pile within which Lowell spoke at Harvard, but Lowell was not alone among the intellectuals of his day who, through lack of taste, would have adjudged Memorial Hall as beautiful.

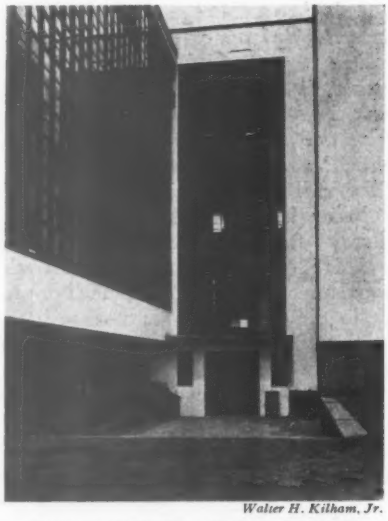
Hawthorne wrote of Salem in 1849; "So far as the physical aspect is concerned, with its flat, unvaried surface, covered chiefly with wooden houses, few or none of which pretend to architectural beauty; its regularity, which is neither picturesque nor quaint, but only tame . . . it would be quite as reasonable to form a sentimental attachment to a disarranged chequer board." This sounds strange today when Salem is an architectural mecca and Samuel McIntire's name has been enshrined among the great.

Cultivation of America's architectural taste and discrimination, however, is not considered hopeless by the American Institute of Architects. In fact, the committee on education of that body seems to be making admirable progress as its chairman, Professor William Emerson, Head of Technology's Department of Architecture, indicates in his annual report.

The committee, aided by the Carnegie Corporation, has been sponsoring summer courses at Harvard and the University of Oregon designed to "reinforce the gospel of an understanding of the arts in the everyday life of every citizen." Traveling lecturers have also been employed by the committee, most important of whom is C. Howard Walker, Lecturer on the Philosophy of Architecture at Technology, and who, Professor Emerson reports "continues to be our most aggressive advocate." With the coöperation of the American Library Association, literature is being written and distributed to acquaint the public with the significance of the fine arts. It was unfortunate that the arbiters of the Victorian "Reign of Terror" lived too early to come under the influence of this educational program.

## *Planners of Cities*

LAST SUMMER, in mourning the passing of George Burdett Ford, '00, the New York *Times* paid tribute to his eminence in the profession of town and city planners whose members "must build on things as they are, working chiefly with such tools as they are able to fashion out of goodwill, guidance and coöperation." For Mr. Ford was general director of the Regional Plan for New York and dealt with



*Walter H. Kilham, Jr.*

BAUHAUS INSTITUTE, DESSAU, GERMANY, DESIGNED BY WALTER GROPIUS

the municipal rearrangements of a thickly populated area a tenth larger than the State of Connecticut. Besides, he had been city planner for 18 other American cities, zoning consultant for 50, and adviser to the French government on the rebuilding of war-devastated Rheims and Soissons.

New York's effort to recapture some of its lost opportunities for orderly growth is by far the most stupendous undertaking of the kind ever recorded. Yet town planning is not a new science and there are considerably more ancient examples than turreted Babylon, long cited as the earliest planned city. Nor is zoning of recent origin for in Roman law there were restrictions on the height of tenements and the locations of brickfields and cemeteries.

But planning in the grand manner came about in Italy during the Renaissance and spread to France. The accomplishments of André Le Nôtre under Louis XIV at Paris and Versailles and Sir Christopher Wren's uncarried-out designs for the rebuilding of London after the Great Fire of 1666 had much subsequent influence. One also recalls among great planners Inigo Jones, Penn and his scheme for Philadelphia in 1682, Bull and his plan of Savannah, Ga., Peter the Great with his lay-out for his capital on the Neva in 1703, Pierre Charles L'Enfant designing Washington in 1791 on such "a scale as to leave room for the aggrandizement and embellishment which the increase of wealth of the nation will permit it to pursue at any period, however remote."

None of these, however, had to contend with the problems confronting Mr. Ford, and the city planners of this day and generation do not possess the arbitrary authority of Baron Georges Haussman who laid out the Bois de Boulogne but is principally remembered by the boulevards he slashed through Paris during the heyday of the last Napoleon. Paris, incidentally, is now spending $40,000,000 in a traffic relief program of new highroads, new bridges, underpasses, overpasses, and new boulevards. The Baron's grandiosity evidently failed to provide for today's urban concentration due to high buildings and automobiles, so Paris must modernize itself.

*Walter H. Kilham, Jr.*

GROPIUS IS ONE OF GERMANY'S FOREMOST EXPONENTS OF MODERNISM. SEE PICTURE OPPOSITE

To automobiles, however, is probably to be credited the fact that tendencies for good city planning are now better than they have been for several generations because, as the *Times* phrases it: "With the coming of the motor age the man in the street for the first time stopped to listen to what they (the city planners) had to say . . . He found his movements hampered, his goods delayed, his time wasted. He lived under constant pressure like a deep-sea fish. His community found its budget mounting, its leading citizens moving into the suburbs where their children could breathe, its industries threatening to go where they would have more room and lower taxes."

*Roberts*

BUILDING THE DELAWARE RIVER BRIDGE AT PHILADELPHIA. WELL-INFORMED PONTISTS WILL RECALL THAT IT IS ONE OF AMERICA'S LONGEST AND MOST BEAUTIFUL SUSPENSIONS

Also a change in the city planner's conception of the city to that of a ***machine à habiter***, to employ the phrase of Le Corbusier, whose "Voisin" proposal for the center of Paris was described in an article in The Review last April, has made for a better appreciation by the man in the street. Architectural dignity with spacious avenues and plazas and handsome arches and monuments remain fundamental objectives, of course. But in the "city beautiful" of today the abatement of smokes and smells and noises, set-back buildings to let in sunlight, railroad electrification, the easy flow of street traffic command attention as do utilitarian items of longer standing like water supply, sanitation, and fire protection.

## *The Difficulties of Tea Tasting: Or the Possibility of a Smokeless Fuel*

ONE need scarcely insist upon the depressing effects of smoke and gloom in cities, for they were officially recognized as early as the reign of Queen Elizabeth whose

*International*

ENGLAND'S CURIOUS AND SECRETLY DESIGNED HUSH-HUSH LOCOMOTIVE PASSING OVER THE FIRTH OF FORTH BRIDGE

royal proclamation forbade burning coal in London during periods when Parliament was sitting. Besides damaging health, property, and vegetation, the smoke nuisance necessitates enlarged outlays for maintaining buildings and other structures, for washing, cleaning, and artificial lighting.

The results in modern cities can be imagined when it is estimated that soot accounts for a deposit of 460 tons annually on a square mile in Chicago; that the duration of sunshine in the British towns of Leeds, Sheffield, and Birmingham in the winter months is less than half that in the outlying districts; that smoke clouds may reduce solar energy by as much as 40%, making for colder weather and greater fuel consumption. One enthusiastic reformer has held that smoke increases humidity and thereby lowers the sensitivity for odors, taste, and touch, making it difficult for tea tasters and perfumery experts accurately to ply their trade.

Because news of these baneful effects is spreading (the tea tasters' guild may be partially responsible), public interest in smoke abatement increases. Since coal has for years been mankind's main source of fuel, (and smoke!) and because anthracite is scarce and expensive in many parts of the world, while bituminous is fairly plentiful, attention has been directed to converting bituminous, especially for domestic use, into an ignitible, solid, smokeless fuel. One way to do this is by a low-temperature (around 400 degrees C.) carbonization method, the object being to produce a resultant of high calorific value with coal tar and gas as by-products.

Undaunted by the record in Washington of over a thousand commercially unsuccessful patents involving low-temperature carbonization of coal, a plant to convert Illinois and Indiana bituminous into the equivalent of high grade anthracite started operating last month in Chicago. Said by its backers to employ a process developed after eight year's experimentation, the plant's capacity is to be 600 tons daily and from each ton of bituminous with a volatility of 36%, are to come 1,400 pounds of char with a volatility of 12%. To this will be added petroleum asphalt as a binder to form a pillow-shaped briquet, trade-named "Prestcoke". Being a secret process in what its inventors evidently believe to be an essential detail — a specially designed carbonizer — no accurate prediction as to the technical effectiveness of the venture is possible at this writing.

Commercially, however, like other low-temperature carbonization processes, the resultant briquets must fetch a price at least equivalent to the purchase price of bituminous coal, that is to say "Prestcoke" must find a market at a higher price per ton than that of the bituminous, leaving the tar and gas by-products to cover the cost of operation and provide for profit. The question is

*Galloway*

WEAVING THE MILE-LONG CABLES OF THE HUDSON RIVER BRIDGE

Galloway

NORMAL MIDDAY TRAFFIC ON FIFTH AVENUE, NEW YORK CITY. ALMOST EVERY AMERICAN CITY HAS ACUTE TRAFFIC PROBLEMS WHICH WILL BE SOLVED ONLY BY BOLD AND FORWARD-LOOKING CITY PLANS. SEE PAGE 26

really whether in the Chicago area where anthracite is costly, there are enough public-spirited householders with an appreciation of the ultimate high cost of low-priced bituminous due to the smoke nuisance.

A more hopeful development is the increasing use of gas. Having slumbered for years, this industry is now awakened to its opportunities, and the sale of manufactured gas is quadruple what it was 25 years ago while the output of natural gas climbed from 662,000 million cubic feet in 1921 to 2,000,000 million cubic feet in 1929.

Stimulated by the production of welded pipes noted on page 30, natural gas is now being distributed through nearly a quarter million miles of pipe line, from Louisiana to Georgia, from Texas to Oklahoma and to St. Louis. Plans are afoot for piping it into Chicago, a project encouraging to Chicago tea tasters, if not to the backers of "Prestcoke".

## *Ice from Mexico; Peaches from Georgia*

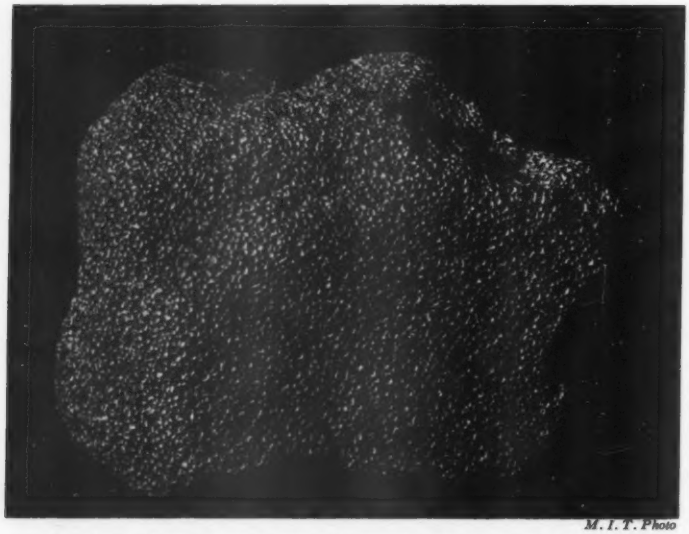
". . . . hot ice and wondrous strange snow,
How shall we find the concord of this discord?"
— Shakespeare

DRY ICE — solidified carbon dioxide which does not melt but evaporates — is well known and widely used as a clean, improved substitute for ice. Its production (about 350 tons a day) has been limited, however; its price high (about $100 a ton). Reason: the necessity of manufacturing the carbon dioxide gas synthetically.

Cheaper $CO_2$ solidified may be in the offing. According to news from the Quebracho oil fields in Mexico, the Globe Petroleum Company, while drilling for oil, has discovered an apparently inexhaustible supply of carbon dioxide gas and has installed a plant to solidify it (by reducing its temperature to minus 78° C.) into cubes weighing 45 pounds each.

Three of the Ward Line's steamers in the Tampico-New York service have been equipped to carry 200 tons of these cubes in separate compartments entirely enclosed and insulated with 12-inch walls of cork — the heaviest insulation on record.

Any method for more cheaply obtaining and solidifying carbon dioxide will be an impetus to the marketing of quick-frozen foods. Fish, meats, many vegetables and fruits may be so treated, shipped to the consumer, and thawed out ready for eating without detracting appreciably from their original freshness and edibility. A difficulty in this marketing method, however, has been lack of facilities for refrigerating quick-frozen foods at the retail point. It is necessary to keep them at a temperature of 15° or 20° F. and special storage cabinets using solidified carbon dioxide have been designed to side-step



*M. I. T. Photo*

A SAMPLE OF AEROCRETE, THE NEW LEAVENED CONCRETE. SEE PAGE 31

this difficulty. It is necessary, however, for the retailer to be able to purchase solidified carbon dioxide at a cheaper price than it is at present obtainable.

If the dry ice from Mexico proves to be a dependable source of supply in large quantities, or if lime manufacturers near metropolitan centers in the United States find methods for solidifying their waste carbon dioxide, then American housewives may expect to be regaled with frozen-food advertising. The latest development in the field of quick-freezing is its extension to include peaches, most perishable of fruits. A plant has been built in Montezuma, Ga., the center of contiguous peach orchards, for freezing peaches so that they may be shipped long distances with the use of solidified carbon dioxide. Because of these and other manifold uses, a prediction was made at the September meeting of the American Chemical Society, that 30,000 tons of $CO_2$ be used this year.

Students of the history of chemistry will recall that the early Nineteenth Century was the age of the liquefaction of gases and that Thilorier, after developing a method for the manufacturing of soda water, the present ubiquitousness of which is ruining American stomachs, proceeded further and condensed carbon dioxide (1834). Once when he was experimenting with the vessel containing the gas in liquefied form, he found that when the liquid was allowed to escape through a jet into a heat-insulated box, a snow-like solid was formed. This substance is the dry ice now being shipped to New York from torrid Mexico.

## *Welding Progress*

FOLLOWING the successful operation of the S. S. *Carolinian*, the first all-welded, self-propelled vessel in American maritime history, the Charleston (S. C.) Dry Dock and Machine Company is estimating on six more ships of the same type. Twice since the *Carolinian* steamed past Fort Sumter Light on her maiden voyage, which was reported in The Review last April, she has been drydocked and examined for leaks or distortions. So far none have developed.

This electrically-welded, rivetless oil tanker with a 2,500 barrel capacity is 120 feet in length with a beam of 23 and a draft of 10. Besides a saving of a fifth in weight and a quarter in construction cost over a riveted vessel, her builders estimate her cargo space was increased 20,000 gallons.

The success of the *Carolinian* is probably responsible for the design of a 200-ton barge to be built immediately for the Inland Waterways Corporation. It is to be welded along the seams, effecting thereby a saving of $15,000.

*Duluth Chamber of Commerce*

FREIGHT YARDS OF THE DULUTH, MISSABE, AND NORTHERN RAILROAD, ORE-CARRIER FOR THE GREAT MISSABE IRON MINES

Galloway

THE *DAILY NEWS* BUILDING, NEW YORK

Another boost for arc welding is to be noted in the plans of an all-metal apartment house designed for early erection in Chicago. They call for use of the battledeck type of floor, demonstrated last spring at the meeting of the American Institute of Steel Construction at Biloxi, Miss., and mentioned in the March Review. The floors are to be placed on 25-foot spans and, with the conventional flat-arch tile construction, they would be 16½ inches thick. Use of the battledeck type of floor, only nine inches thick, is to save enough space to get 21½ stories in the height allowed for 20 under usual construction methods. A welded building with aerocrete floors (described adjacently) would be the lightest of the light, *ne plus ultra* in space economy.

Still a fourth item, from Milwaukee, is perhaps of larger immediate import. There the A. O. Smith Corporation, the company which turns out nearly 10,000 automobile frames a day in a plant run by only 120 men, has successfully increased the capacity of its welded pipe plant. The pipes are made by rolling steel plates longitudinally into tubes and welding the seams, and it is used primarily for large-diameter gas line pipe. In 1927 the plant started with a capacity of ten miles per day; it is now producing 32 miles a day almost entirely by automatic machinery. Before leaving the factory, the pipe is hydrostatically stressed up to 22,000 pounds per square inch. It is very seldom that the slightest leak is found in the welded seam.

## *Leavened Concrete*

TURNING to the humble baker of bread for inspiration, research has produced a building material of concrete which is composed of countless minute cells produced by a chemical process akin to the action of yeast in bread dough.

Aerocrete, as this new material is known, was originally developed by a Swedish scientist, who was able to make a serviceable substance, although it would not withstand great weight. Two years ago aerocrete was introduced in the United States and, following studies at Columbia University, it has been improved so that it now meets the most exacting fire and water-load tests required for flooring materials in New York City.

Its components are Portland cement, sand, and small quantities of lime, aluminum powder, and soda. The aluminum powder in an alkaline solution causes a chemical reaction when this mixture is poured in a thick liquid form, and the hydrogen liberated is the leaven that forms the cellular structure. The "rising" process is completed within an hour, when hardening sets in. Control of the ingredients makes it possible to vary the expansion from 50 to 150% of the original volume.

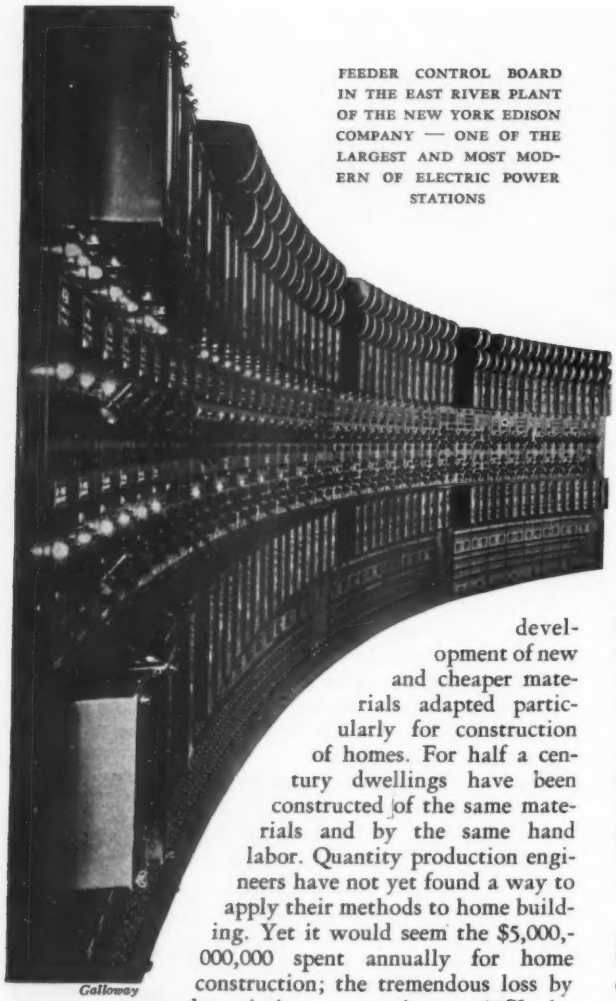
Recent tests of the new material showed that a floor of aerocrete 4½ inches thick kept a temperature of 139 to 207 degrees on its upper surface during the last hour of a four-hour fire burning beneath it at a temperature of 1,825 degrees F. In a fireproof building the temperature of a fire will rarely exceed 1,700 degrees.

Galloway

NUMBER 10 EAST 40TH STREET, NEW YORK

The advantages claimed for aerocrete as a structural floor are its lightness (its weight is 20 to 75% that of concrete), high heat-insulating value, and sound-deadening properties. It is estimated that it will reduce by one-fourth the weight of steel required to support a building, a reduction comparable to that afforded by welding (see page 30).

The high cost and limitations of present building materials, fire hazards and the expense of maintenance have been cited by Professor Ross F. Tucker, '92, head of Technology's Course in Building Construction, as indications of the need for



FEEDER CONTROL BOARD IN THE EAST RIVER PLANT OF THE NEW YORK EDISON COMPANY — ONE OF THE LARGEST AND MOST MODERN OF ELECTRIC POWER STATIONS

Galloway

development of new and cheaper materials adapted particularly for construction of homes. For half a century dwellings have been constructed of the same materials and by the same hand labor. Quantity production engineers have not yet found a way to apply their methods to home building. Yet it would seem the $5,000,000,000 spent annually for home construction; the tremendous loss by depreciation, amounting to 10% the first year; and the $500,000,000 annual write-off in this country because of flimsy construction, offered a worthy incentive to produce better materials and devise better methods.

## *Floating Power Houses*

MUCH attention was created last year when the airplane carrier U. S. S. *Lexington* berthed at Tacoma, surrendered its mobility, and operated its generators to boost the power supply of that city while hydroelectric plants were incapacitated by drought.

It was this unique service rendered Tacoma by the Navy that might have convinced the New England Public Service Company of the feasibility of a floating commercial power plant it has long had under consideration. At any rate, has it purchased a 7,000-ton cargo ship, the *Jacona*, and is converting it into a power plant of 20,000 kilowatts capacity.

This floating plant will cost $1,000,000, but its owners estimate that it will be available for nearly twice as many hours of service per year as an equivalent stationary power house in the New England system.

To any point of the coast where there is a power shortage, the *Jacona* will steam, anchor, or slip into a suitable berth, and make an electrical tie-in to the local power system. Thus, a supply of energy up to 20,000 kilowatts can be made available in a few days, in contrast to the weeks or months required for building a new transmission line or power house.

## *Mastering Rivers in the Laboratory*

A NATIONAL hydraulic research laboratory to be operated by the United States Bureau of Standards, of which Dr. George K. Burgess, '96, is director, is now in process of planning by a committee of the American Engineering Council. At present two of its members, John R. Freeman, '76, internationally known hydraulic engineer, and William B. Gregory, Professor of Experimental Engineering at Tulane University are making a study of the largest of the famous European laboratories where the value of research of this nature has long been recognized.

Mr. Freeman's knowledge of, and interest in hydraulic research had much to do with the opening this year of such a laboratory at the Institute. Here, under the direction of Professor Kenneth C. Reynolds, '25, who spent more than a year in Europe in hydraulic research, the new laboratory, one of the first of its kind in this country, is engaged in studies of fundamental importance.

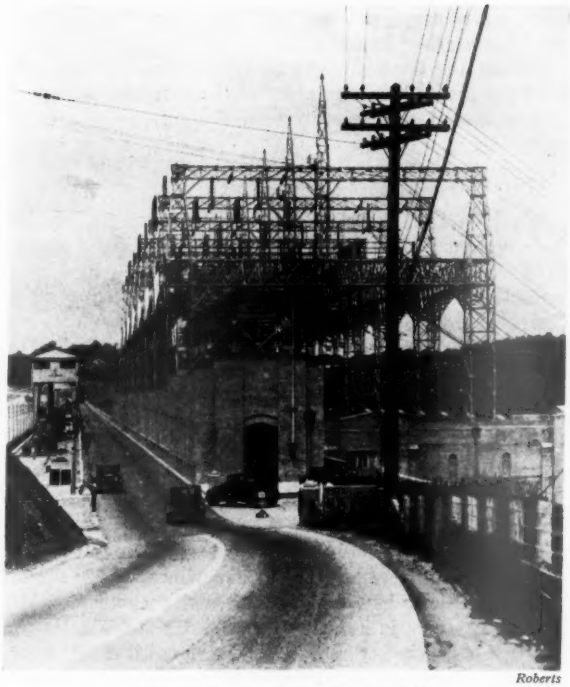
The projected national hydraulic research laboratory was authorized by the last Congress to meet a growing demand for a scientific solution of the control of the waters of rivers and harbors, design of dams and power projects, investigation of the laws governing the flow of waters, and the resistance of various types of soil to the action of liquids.

The value of such research is attested by the types of problems investigated in Technology's hydraulic laboratory: the design of an earth dyke for control of the waters of the Connecticut River at Hartford, Conn., which study entailed construction of a scale model to observe the action of the water under various conditions of flood control; methods for preventing erosion in the bank of the Connecticut River at a sharp bend near Northampton, Mass.; tests on a model of a power dam in Pennsylvania which revealed the need for changes in design of the spillway and river-bed below the actual dam.

## *Road Congress*

ASSEMBLED in Washington the first week of this month are the delegates from 60 odd nations represented at the Sixth International Road Congress — an international conference in which no one will be asked or expected to surrender any fancied national security. This uniqueness, and the records of previous Congresses (Paris, 1908; London, 1913; Seville, 1923; Milan, 1926), together with the activities of the Permanent International Association of Road Congresses, the body which cares for a continuity between meetings, make the outlook for Washington seem hopeful indeed.

The agenda comprises, of course, papers on manifold broad questions such as how best to lay bitumen, asphalt, brick, tar, or concrete, accepted practices for financing



*Roberts*

ROADWAY ACROSS CONOWINGO DAM

highways, regulating traffic, and the like — questions which disregard international boundaries. There will be trips to laboratories in and about the capitol and arrangements include an exposition of modern road machinery. Also the chance presented foreign delegates to make a first-hand, full-scale study of the roads of North Carolina, only a short jump south from the Potomac and surely the finest highway system of any state in the Union, will be tempting.

Together with the proud account of Iowa's final emergence from the mud, the Congress may expect to hear how Siam successfully builds crownless, dirt highways, allowing the water from frequent and torrential rains to drain to the center and seep through, thus helping compact the earth. Iowa, parenthetically, captures this year's *cordon bleu* for hard-surface pavement on her record of laying four miles of concrete per working day. Three-quarters of her 1,025-mile 1930 program were down by September 12, and on that day Nebraskans celebrated, for Omaha was at last linked by a continuous pavement with the sea.

Besides Siam, other far away places will report: Finland, on her 230-mile gravel road within the Arctic Circle and leading to the Fjord of Petsamo; six Central American countries on their 566 miles of graded or finished roadway between Mexico and the Canal Zone. The remaining 1,058 will be completed before long and will connect with the international artery between Laredo, Tex., and Mexico City, to be in operation during 1931. Some references may be also expected to the proposed turnpike down the spine of South America. Colombia is building rapidly, Ecuador is favored by natural rock roads along her coast and, in Peru a 1,300-mile coastal road was being improved by the previous government. Some day balloon tires may roll from Labrador to Cape Horn.

Notice also is bound to be taken by the Congress of experimental construction practices now undergoing trial and the growing tendency to permit higher speeds of traffic to relieve congestion. The novel metal base highway started last month in Illinois consists of a wearing surface laid on an iron plate directly on the subgrade. If a success, it ought to threaten the prestige of the massive concrete slab which, in 25 years, has become accepted as a prime essential of a heavy duty road. As to speed limits for motor vehicles, England and five American states (making a total of 11) abolished them this year. Instead of speed, dangerous driving becomes the criterion for reprehension. Besides these five states converted to the "reasonable and proper" column, four others this year have boosted their allowable limit by 5, seven by 10, and one by 15 miles per hour. The growing density of traffic makes it imperative that it move fast.

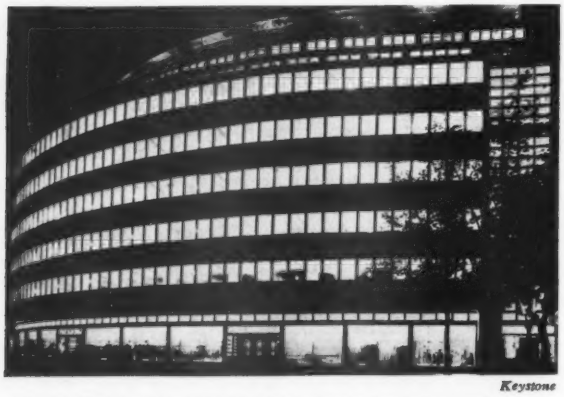
Consideration will undoubtedly be given to the effects of good roads aside from affording improved transportation facilities. Think of what the thousands of automobilists freely crossing and recrossing the Canada-U. S. border daily do towards promoting a better common understanding between the two countries; contrast China, thickly settled but comparatively roadless, with Europe; study the growth of the United States between 1904 when there were 150,000 miles of *surfaced* highways with only 141 miles *paved*, and 25 years later when 600,000 miles were surfaced including 90,000 paved and 40,000 hard-surfaced. Obviously the interchange of ideas by delegates will be most stimulating and helpful and a corps of translators will be of inestimable aid by making the papers available in four languages: English, French, German, and Spanish.

But in a larger sense the lasting benefit of this initial

AERIAL EYE AND ITS OPERATOR. FAIRCHILD K-3 MILITARY CAMERA SIMILAR TO THAT USED BY DOOLITTLE AND STEPHENS IN TAKING PHOTOGRAPHS 37,000 FEET, THE RECORD

*Popular Mechanics*

cisatlantic Road Congress may be expected to derive from provoking world-wide thought on the possibilities for improving international amity, social conditions, internal goodwill, and economic stability by the expansion of highway systems.



*Keystone*

NIGHT VIEW OF A BERLIN DEPARTMENT STORE DESIGNED BY ERICH MENDELSOHN. NOTE THAT CARRYING COLUMNS ARE NOT APPARENT, PERMITTING THE CONTINUOUS WINDOW STRIPS

## *Who's Who*

LAWRENCE W. WALLACE, enterprising executive of the American Engineering Council, has completed a study of the engineers and architects listed in "Who's Who in America" (1928–1929).

He finds that among the 28,805 notable living men and women in the United States listed in this directory, are 2,858 engineers and architects. Among the 2,858 are 1,417 academic degrees in branches of learning other than science as well as 2,497 scientific degrees, and memberships in 1,138 associations, conferences, boards, and commissions, of which half are non-technical.

In this group of engineers and architects, there are, or have been, ten governors, 13 members of Congress, two members of the Cabinet, and the President of the United States. Five hundred and eighty-eight hold 905 memberships in Phi Beta Kappa, Phi Kappa Phi, Sigma Xi, and Tau Beta Pi, the four honorary fraternities in which membership connotes recognized ability in the field of scholarship. These engineers and architects also hold 4,785 official positions in 3,928 organizations, of which 2,993 are industrial and commercial companies. The position of president in industrial and commercial organizations is held by 1,128, in engineering firms by 72, in banks and trust companies by 68, in colleges by 23.

Their great influence in public life is indicated by the fact that over one-half of them have served, or are serving, municipal, state, or federal governments. To the operation of city governments 208 are contributing, and their total number includes 28 city engineers, 18 mayors, six city managers, three chiefs of police, and two superintendents of city schools.

At the time of the investigation, 59 were in state work. Mr. Wallace states that out of the group besides the ten governors have come five legislators, and a state district attorney. The present governors of Delaware, Utah, Wyoming, New Jersey, Alaska, and Alabama are engineers, and the governors of North Carolina and Indiana hold engineering degrees.

Besides the President of the United States, engineers hold the portfolio of Secretary of the Interior, Secretary of Commerce, and Director of the Budget.

## *Aviation Novelties*

ONE of the abandoned flying experiments of the Wright Brothers — that of obtaining lifting power from rotating cylinders instead of wings — has been resuscitated by three inventors who are working on a design of this type off Mamaroneck, Long Island.

Their model, aside from being wingless, is similar in appearance to a seaplane. The traction power is supplied by a three-bladed steel propeller driven by a single motor located in the nose of the plane. To obtain lifting power, an auxiliary motor supplies the power for rotating the cylinders which replace the wings.

The principle involved in this experiment is an aeronautical adaptation of the Flettner rotor ship which German engineers in 1925 claimed would revolutionize marine locomotion. Subsequent experiments have shown this principle to be workable although inefficient.

"With safety in aviation occupying the center of the stage," remarked a prominent aeronautical engineer, "I can't conceive of a plane, obtaining its lifting power from rotating cylinders, playing a very prominent part in the future of aviation. If the auxiliary motor should stop, the plane would drop to earth like a pancake."

Curtiss-Wright Corporation is reported to have already spent $200,000 to develop a vertically rising aircraft and is still experimenting.

The difficulties it faces are immense. Helicopter models, only a few feet in diameter, have made inspiring performances, but when such craft are made sufficiently large to lift people, many unforeseen construction difficulties present themselves which are non-existent in the models. In small models, the rotating surfaces are extremely light and do not require the structural bracing which is necessary in full-sized machines. These rigorous demands of aerodynamics are obstacles which must be met before vertically rising machines become a reality.

## *American Chemical Society Growth*

NEWSPAPERS have published many columns about the meeting of the American Chemical Society in Cincinnati, early in September. It is pleasing evidence of the recognition the public is giving to the great scientific societies, of which the Chemical is certainly one of the largest and most influential.

In the past 25 years, according to the President's report, the American Chemical Society has grown in membership from 3,079 to 18,000 and has increased its budget from $15,000 to $557,000.

During the present year, it will spend $486,000 in publishing its journals and documents. In spite of this large appropriation valuable articles would remain unpublished without the assistance of funds given by the Chemical Foundation. Around $95,000 has been supplied beyond the normal amount the Society has available for reporting scientific work.

# BOOKS

## *An Obstinate Stalking of Ultimate Reality*

PROCESS AND REALITY: AN ESSAY IN COSMOLOGY, by A. N. Whitehead. $3.00. xii+547 pages. Boston: *Macmillan.*

PROFESSOR Alfred North Whitehead's "Process and Reality" may with especial appropriateness be described in the terms which William James once proposed to apply to all metaphysics. It is an unusually obstinate attempt at clear and correct thinking about ultimate reality — the actual nature of the cosmos as distinguished from its apparent nature. It deals with the totality of the universe and its internal relationships, as distinguished from the artificially separated slices of it with which the several sciences deal in isolation.

The sciences, because of their necessary refusal to examine the universe as a whole, cannot give us the complete truth, but only a useful approximation of the truth about special aspects of the universe.

"Every scientific memoir," says Professor Whitehead, "in its record of the 'facts' is shot through with interpretation," though he is willing to add later that "the chief danger in philosophy is narrowness in the selection of evidence."

"Process and Reality" proposes a new cosmology, "a system of ideas which bring the aesthetic, moral, and religious interests into relation with those concepts of the world which have their origin in natural science." It is based on certain aspects of the philosophy of Plato — especially the *Timaeus* — Aristotle, Descartes, Hume, and Locke.

It begins by repudiating — "in so far as concerns their influence on philosophy" — nine prevalent habits of thought, some of them very popular in scientific circles at the moment. These include the distrust of speculative philosophy, "trust in language as an adequate expression of propositions," Kant's doctrine of "the objective world as a theoretical construct from purely subjective experience," and "belief that logical inconsistencies can indicate anything else than some antecedent errors."

Professor Whitehead blames "these nine myths and fallacious procedures" for many of the snags into which nineteenth century philosophy ran. Language he regards as an especial difficulty. Save in the limited sphere of mathematics, we have no adequate instrument for the expression of our thoughts. Yet, if we poor limited humans would convey our ideas to one another at all, we must use language, which — whether adequate or not — is the only means we have.

Thus on his guard, Professor Whitehead through 50 cautious pages defines his terms and states four sets of categories, one of which includes 27 fundamental propositions. He then launches forth on his cosmology.

He begins with the fairly obvious fact that the conventional scientific views of cosmology can no longer rationally explain scientific observations of various aspects of the universe in terms of the whole universe. The old physics is inadequate. The universe cannot be "static stuff," matter whose nature is forever fixed. We know it to be "fluent energy." This is ultimate. It has, in the endless and beginningless history of the cosmos, passed through four phases, the first of which is God. God has two aspects, or, as Professor Whitehead puts it, "the nature of God is dipolar. He has a primordial nature and a consequent nature." The first of the four phases of the cosmos is the unmoved mover, outside of time and space, the primordial aspect of God. In the second phase, this Primordial Divine takes form in actuality, the world we know of what is conventionally called "matter" — stars and subway trains and sheets of paper with book reviews printed on them, not to mention the human race.

The third is a "perfected actuality," in which the many and the one are united, "the ultimate unity of actual fact with the primordial conceptual fact." And finally, there is the other pole of God, so to speak, or what Professor Whitehead calls the "consequent nature of God." This "is conscious; and it is the realization of the actual world in the unity of his nature, and through the transformation of his wisdom."

"Philosophy," says Professor Whitehead, "never reverts to its old position after the shock of a great philosopher," and it is safe to say that philosophy will never revert to its old position after the implications of "Process and Reality" are fully comprehended, and the "philosophy of organism" which it expounds is understood.

One might almost call this a scientific philosophy. The phrase, it is true, would not please the author, whose system takes up all the sciences into something larger than themselves. But the phrase at least suggests the patient willingness to proceed by slow degrees and not profess omniscience, which is the best evidence of the scientific spirit. Professor Whitehead has faith in speculation as a means of attaining truth, not because he thinks it is infallible, but because he thinks it helps the mind of man to move closer and closer to ultimate truth about ultimate reality.

Even in presenting this finished metaphysical system, he is "quite aware how shallow, puny, and imperfect are efforts to sound the depths of the nature of things."

At least, speculation is no worse off than plain, everyday, inductive, brass-instrument science. The history of thought is littered with discarded metaphysics, but it is quite as littered with abandoned scientific theories. After all, "we no more retain the physics of the Seventeenth Century than we do the Cartesian philosophy of the century." Philosophy is chiefly important as a means of fusing religion and science "into one rational scheme of thought." It may never reach complete success (any more than science does); but "at the very least, men do what they can in the way of systematization, and in the end achieve something. The proper test is not that of finality, but of progress."

JOHN BAKELESS

## *The Mysterious Mr. Smith*

GEORGE EASTMAN, by Carl W. Ackerman. $5.00. xviii+ 522 pages. Boston: *Houghton Mifflin Company.*

"SO FAR as we know," writes Professor Edwin R. A. Seligman in an introduction to this book, "Mr. Eastman was the first manufacturer in the United States to formulate and to put into practice the modern policy of large scale production at low costs for a world market, backed by scientific research and extensive advertising."

As Mr. Ackerman shows in exhaustive detail, so important a contribution to our social order was the resultant of the following achievements and innovations on the part of Mr. Eastman:

1. The invention of the first film, the coat of which was stripped after exposure and developing, making a transparent photographic negative
2. The development of nitro-cellulose film (experimented with by Eastman, patented by Reichenbach, his associate)
3. The invention of the machinery and processes for making film
4. Creation of a company to manufacture film and of the Kodak to create a market
5. Manufacture of the first film for Edison's Kinetoscope, the first motion picture camera
6. Elimination of electricity from film
7. The development, manufacture, and marketing of film in continuous reels
8. The engagement of a trained chemist to devote all his time, at the expense of the business, to chemical research — one of the earliest known recognitions of pure research as an aid to industry

It required an inventor who was also a business genius; a business genius, who was also a practical idealist, to thus achieve a scientific victory and simultaneously to usher in a new economic procedure. For having combined these qualities and used them with unprecedented efficiency, Mr. Eastman became, as Nicholas Murray Butler has said "a literally stupendous factor in the education of the modern world," and as Lord Kelvin many years before had seen, one of the greatest contributors to scientific research. (What a debt, for instance, astronomy owes to photography!)

One is inclined to feel, however, that the development of the photographic industry was, as values stack up, of lesser importance than the recognition and impetus Mr. Eastman gave to industrial research. This was something fundamental, of infinite fruitfulness, a source of economic and political progress.

It was also the source of Mr. Eastman's interest in the Institute of Technology. "While formulating plans for a new plant," writes Mr. Ackerman, "he communicated with Technology and employed Darragh de Lancey, of the class of 1890, placing him in charge of the first construction work at Kodak Park.

"In 1891, searching for another research chemist, Eastman asked Dr. Drown, the distinguished Professor of Analytical Chemistry at the Boston institution, for recommendations, adding that he had 'a great deal of confidence in the material you turn out at your institution.' During the next few years Eastman engaged Lovejoy, Haste, and other 'Tech men.' Enthusiasm for this 'material' increased to such an extent that he began to read the annual reports of President Richard C. Maclaurin and study that system of technical education. This continued for nearly two decades, while he observed the industrial asset value of technically trained men and posted himself in the history of that institution."

The result of this "confidence in the material you turn out," as everyone knows was the gift to the Institute by a "Mysterious Mr. Smith" of some 20 millions of dollars. In one of the most dramatic chapters in the whole book, the author sets down the story of the secret negotiations between President Maclaurin and Mr. Eastman, culminating in the great gift.

## *E pur Si Muove*

THE GREAT ASTRONOMERS, by Henry Smith Williams. $6.00. 618 pages. New York: *Simon & Schuster.*

THERE is a legend that Galileo, after being forced to renounce his heretical doctrine of the earth's motion, retired from the presence of his persecutors mumbling "E pur si muove" ("it does move, none the less"). Authentic or not, that legend is true to the spirit of Galileo as it is to the nature of all the "Great Emancipators" in astronomy, from Eratosthenes to Einstein.

It is the courageous spirit of "E pur si muove" that Dr. Smith most emphasizes in his history of these men. In the beginning he forewarns the reader "that if your interest is in stars, as such, rather than in men, this book is not for you. Any textbook on astronomy will better serve your purpose. This is the story of what the great astronomers taught us, not about the stars, but about ourselves."

What the great astronomers have taught us about ourselves Dr. Smith interprets chiefly as a recognition of our gullibility, our susceptibility to prejudice and superstition, our power to triumph over these if we summon to our aid the spirit of Galileo. Bruno did not die, nor Galileo renounce, without contributing thereby to man's escape from the grip of obscurantism, and to his progress toward establishing his true relationship with the universe.

By emphasizing this aspect of astronomy Dr. Smith is able to dramatize much of it in a wholly unobjectional way. Now and then he falls into the polemic and in the following instance to theatricality.

After completing Book I, *The Old Heaven*, he announces by title page Book II, *Astronomy in the Medieval Period*, which contains this sole passage: "From the Council of Nicaea, at which the Emperor Constantine made Europe safe for Athanasian theocracy, to the time of Copernicus, whose great work, teaching that the earth is not the center of the Universe, was to remain under ban of the Council of the Inquisitor until fifteen centuries after the Nicene victory, the record of astronomical progress in all Christendom may most charitably be expressed in these words:"

(three blank pages)

It is deceiving, however, to give the impression that the book is altogether concerned with the effect of astronomy on human nature. Its 618 pages are packed with explanations, diagrams, and demonstrations.

J. R. K., Jr.

# THE INSTITUTE GAZETTE

## *The Institute Begins a New Year*

THE dawn of a new academic year on September 29, finds the Institute looking back on a summer of accomplishment and looking forward toward an increased registration, more dormitory accommodations, increased opportunity to extend financial aid to worthy students, and to many important changes in key personnel.

At a record breaking summer session, 1,650 students attended, a number greater by 150 than the total last summer. Among these students were public health workers attending the Public Health Institute of the Department of Biology and Public Health and a large group of teachers who attended the Institute's summer courses in the teaching of mathematics and science.

Despite all this academic activity, the harassed Buildings and Power Department busied itself by repainting and refurbishing buildings; keeping the growing expanses of grass green and flourishing through a drought and shortage of water in Cambridge; preparing the land west of Massachusetts Avenue to provide parking space for several thousand cars as the Institute's contribution to the National American Legion Convention due the middle of October; flood-lighting the Charles River side of the main buildings as a part of the dressing-up incident to the Tercentenary Celebration; maintaining a watchful lookout for the physical comfort of 46 students and 10 staff members at the 850-acre civil engineering camp in Maine, and the combined staff and student population of 14 at the mining camp in Dover, N. J.; erecting a cabin for outing use at the site of the freshmen camp at Lake Massapoag near Dunstable, Mass.; industriously cooperating with the contractors on the new dormitory; maintaining the Institute's Radio Communication Laboratory at Round Hill; administrating the day to day problems of its 200 odd regular employees with a smoothness and ease to which the official Institute has become accustomed.

## *Registration Forecast*

REGISTRATION is to increase this year if the opinion of the Director of Admissions and the careful forecast of the Registrar throws any light on the matter. The latter, from studies dated September 15, predicts a rise of 8% in the number of entering freshmen and an increase of 4% for the number of students in the whole school.

For use of posterity the yearly counts as of November 1 are kept as the official census totals, but the preliminary report drawn every year on the third day of the first term has from year to year proved trustworthy for comparative purposes. Last year on the third day of the term there were 702 freshmen and on the third day of the present

*M. I. T. Photo*

THE NEW DORMITORIES WITH ACCOMMODATIONS FOR 210 MEN. BEHIND IS ANOTHER WING SIMILAR TO THIS, FORMING THE SECOND SIDE OF A FUTURE QUADRANGLE

PROFESSOR AND MRS. DUGALD C. JACKSON VISIT THE M. I. T. CLUB, CANTON, CHINA. READING FROM LEFT TO RIGHT (BACK ROW): Y. N. CHU, H. C. CHEN, WENTWORTH CHU, '24, H. F. LEE, '25, Y. Y. DAO, C. T. CHU, '22, H. CHEN, '15, S. K. LAU, '19, LONG LAU, '14, Y. M. CHU, '14. (FRONT ROW): W. F. GILMAN, '09, MRS. W. F. GILMAN, MRS. C. T. CHU, PROFESSOR AND MRS. JACKSON, MRS. S. K. LAU, A. R. KNIPP, '09

year, October 1, 1930, Registrar J. C. MacKinnon, '13, foresees 760 members of the Class of 1934. He also anticipates that there will be 420 graduate students, the same as a year ago; some growth in sophomores and juniors and a slight rise in the senior class. The next issue of The Review will report on the accuracy of Registrar MacKinnon's forecast. Perhaps it will publish his apologia.

Any such forecast is, of course, subject to error, but it would appear certain that more freshmen are coming, and that is significant. It will be the fourth successive year that the freshmen registration has shown an increase. Last year the freshman class increased by 25 over the freshman class of the previous year. In 1926–27 the registration included 495 freshmen; in 1927–28, 592; in 1928–29, 668; in 1929–30, 693 (all of these figures are based on the registration as of November 1).

The real significance of these added numbers lies in the possibility of the Institute to be increasingly more selective in the applicants it accepts.

## *New Dormitory*

READY for occupancy this fall, the new dormitory announced in the spring issues of The Review will offer housing facilities for 210 students. This will bring the Institute's dormitory accommodations up to a total of 630. As recommended by the committee comprised of representatives of the Corporation, Faculty, Alumni, and undergraduates which in the spring of 1928 exhaustively canvassed the housing situation, the new unit will contain the policy of "aiming to provide a maximum of necessary comforts and livability without luxury."

## *Personnel Changes*

PRESIDENT Karl T. Compton, of course, will be at the helm when the Institute opens on September 29. He occupies a new office in the room recently occupied by the Personnel Division. His new office is part of a suite which includes the Corporation Room, occupied by Dr. Stratton, Chairman of the Corporation and the secretarial offices incident to both the President's and Chairman's activities.

Many other important additions and subtractions in personnel will be noticeable. Professor William Emerson, Head of the Department of Architecture, will be away on a year's sabbatical leave and during his absence the Department will be administered jointly by Harry J. Carlson, '92, Life Member of the Corporation, and Professor Harry W. Gardner, '94, who will care for the administrative details of the architectural work of the department. Professor William H. Lawrence, '91, will perform a like responsibility for Course IV-A, Architectural Engineering.

Professor Dugald C. Jackson, Head of the Department of Electrical Engineering has returned from a trip around the world and Professor Vannevar Bush, Eng.D., '16, abdicates as acting head. Professor Charles L. Norton, '93, who relinquished his position as Head of the Department of Physics to devote his entire time to the Division of Industrial Coöperation and Research, has turned over his old office to the new Head of the Course, Professor John C. Slater, and now occupies the office directly opposite the entrance to the President's suite.

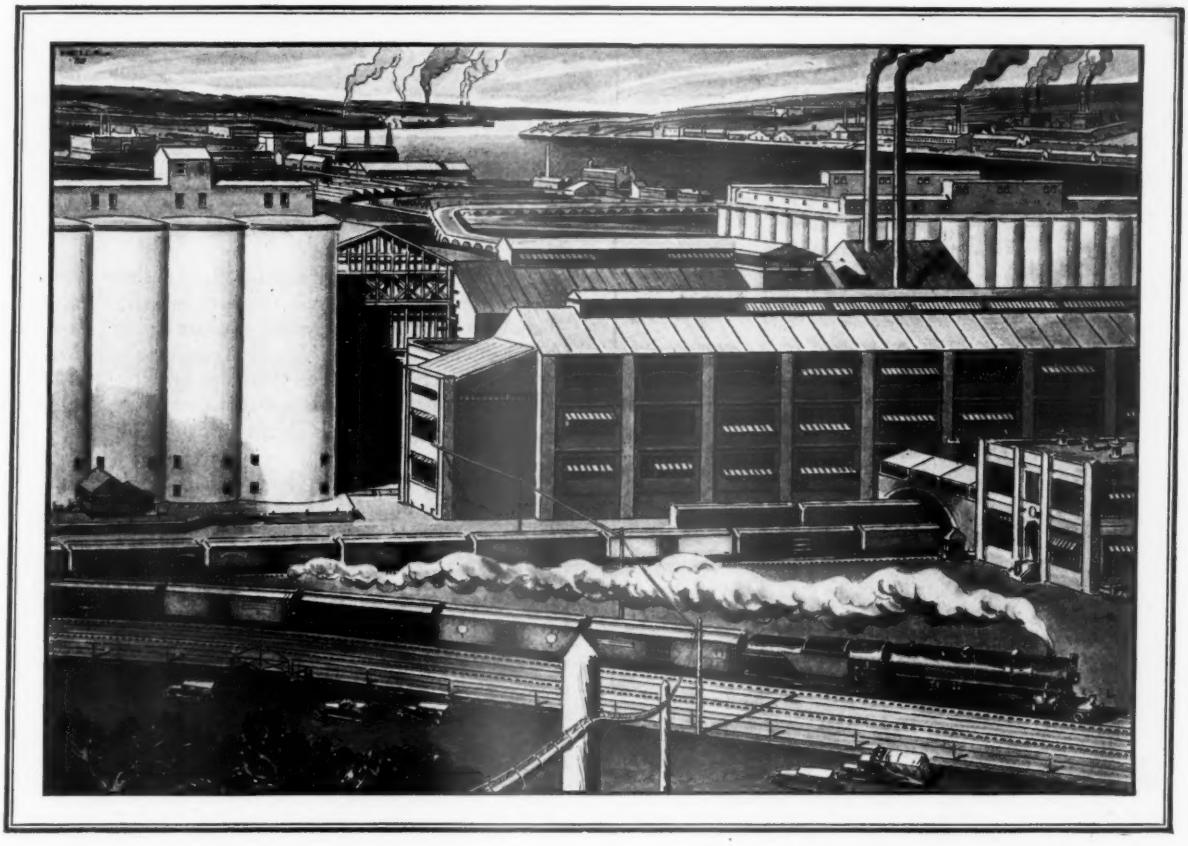
The familiar figure of Professor Harry W. Tyler, '84, who has gone to Washington as a consultant for the Library of Congress, will be missed as Head of the Department of Mathematics. In his place Professor Frederick S. Woods will be found. The new course in Business and Engineering Administration, separate from the Department of Economics and Statistics will come into its own this fall with Professor Erwin H. Schell, '12, as its Acting Head. Professor Davis R. Dewey continues as Head of the Department of Economics and Statistics.

In the Department of Physics there will be a new professor and a new assistant professor, George R. Harrison, of Leland Stanford University and R. M. Langer of California Institute of Technology respectively. F. Alexander Magoun, '18, rises to an Associate Professor of Humanics; Manuel S. Vallarta, '21, to Associate Professor of physics; and Aubrey D. Beidelman, '15, to Assistant Professor of Naval Architecture. Manfred Rauscher, '26, returns to an assistant professorship in the Department of Aeronautical Engineering, and Julius A. Stratton, '23, transferring from the Electrical Engineering Department becomes Assistant Professor of Physics. Resignations from the staff include Joseph L. Gillson, '21, Associate Professor of Mineralogy and Petrography; C. Hale Sutherland, '10, Associate Professor of Structural Engineering (who becomes Head of the Department of Civil Engineering at Lehigh University); Richard A. Wilkins, '18, Assistant Professor of Chemical Engineering.

Leaves of Absence not mentioned above include Henry B. Phillips (one year), Professor of Mathematics; Carroll W. Doten (first half of year), Professor of Political Economy; and Donald S. Tucker (one year), Professor of Political Economy.

## *Loan Fund Additions*

ADDITIONS to the Technology Loan Fund over and above the $4,200,000 announced as subscribed by Gerard Swope, '95, last June include the following: $20,000 by William R. Kales, '92; $10,000 by Edward L. Hurd, '95; and $10,000 by Eugene H. Clapp, '95.



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# ART AS AN AID TO INDUSTRY

(*Continued from page 13*)

years ago one of his daughters was about to graduate from Oberlin College, two children were in high school, and one or two were in the grades. More, he owns his own home, drives his own car, and is a respected citizen in his home town. Industry has many constructive radicals such as he, if only they could be shown themselves.

Look again into his sincere eyes. It was these eyes as I caught them in my portrait that evoked the comment, "Beneker, do you know what you are doing? You are painting Christ into men." Many others who have looked upon this portrait have seen this same quality. Too often in our industrial plants we are still crucifying the great spirit of leadership that is latent among men.

THE story of Peggy Hirsch and Homer are but two out of many that have convinced me of art's great opportunity in industry. "Art," Emerson once said, "has not yet come to its maturity, if it do not put itself abreast with the most potent influences of the world, if it is not practical and moral, if it do not stand in connection with the conscience, if it do not make the poor and uncultivated feel that it addresses them with a voice of lofty cheer. There is higher work for art than the arts — nothing less than the creation of man and nature is its end . . . for the hand can never execute anything higher than the character can inspire . . . proceeding from a religious heart, it [art] will raise to a divine use the railroad, the insurance office, the joint-stock company, our law, our primary assemblies, our commerce, the galvanic battery, the electric jar, the prism, and the chemist's retort, in which we seek now only an economical use. . . ."

If it is possible that art may raise to a divine use these things that Emerson mentions, why has it not done so? The truth is that art itself is largely to blame. If I quote Emerson to any of my fellow painters, they usually reply, "Hell, Emerson did not paint." They are out of sympathy with anything but their selfish technique. Almost every art school of any importance is conducted independently of other sources of cultural and technical training. They fail to teach students how to relate their training to the actual conditions they will find in the bewildering maze of industry that constitutes such a large part of modern life.

As a consequence much of modern art today has become barren and mute. There was a time when art spoke to people and meant much to them; now it is almost reduced to an academic exercise. Little wonder that Dr. Millikan and other scientists, defending science, decry contemporary art as inferior to contemporary science.

They are right, but how regrettable it is that they are right. A mathematician of note has pointed out that science has progressed at the rate of multiplication while art has progressed not even at the rate of addition. That this one-sided growth is unfortunate is, I think, indisputable. Science and art should proceed together hand in hand if we are to make the way of life smoother and more peaceful. Each is useless in itself; each is dependent upon the other. We should not let science (*Continued on page 42*)

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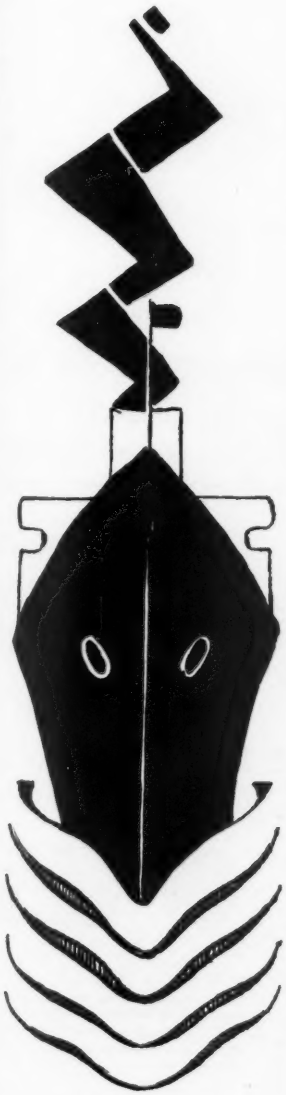
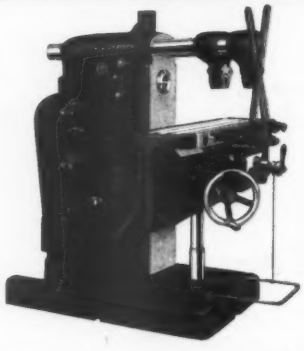


Load—
*then step on the foot treadle*



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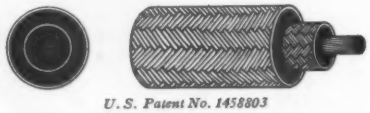

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# ART AS AN AID TO INDUSTRY

*(Continued from page 40)*

run away with the job of living. Since science begets industry, the corollary follows that industry bereft of art and its saving graces is lop-sided and inefficient.

Men of science go to nature, down to the infinitesimal electron. Artists also — at least some of them — go to nature for their inspiration. But in science the whole object is torn apart into its indivisible elements. Art takes all of these parts and builds them into something whole and, let us hope, into something beautiful. It is the difference between analysis and synthesis. Steinmetz once remarked that "all this development of natural resources is absolutely useless unless we develop along with it the spiritual nature in man, in which all that is best in art can help."

Most of us think of pictures when the word art is mentioned, but that is delimiting the term too narrowly. We must learn to conceive of art, not as a thing, but as a way of doing things, even as a way of living. Because the artist loses a sense of background in acquiring a limited technical training and a materialistic outlook, we gain the impression that the work of an artist is a method of putting paint on canvas. Many of us working in the field of the finer arts fail to realize that we have little, if anything, to say to the people through our art which may influence them for good or for evil. The artist must first realize the richness and fullness of life himself before he can share it with others. No wonder the scientists criticize our modern art as neurotic and over-sexed; no wonder we hear of censorship.

When business is conducted so inartistically as to produce such evils as war and unemployment, is it not time that we bring in outside influences such as art, the catalyzer, which has the power to unite elements without losing its own identity? From earliest times art has always been a means of communication. If it were not so, why should we spend millions of dollars to dig up the earth in the far east and at home to discover what man said to his neighbor in past ages?

From the beginning art has also been the handmaid to belief, to religion. Today we seem to avoid the word religion and tend to look upon it as a form rather than a way of living; as a creed rather than an effort to live in harmony with the universal laws of nature. Regardless of what we may call ourselves denominationally, there is back of these many forms one fundamental principle, our heritage from the past — the principle which gives life and by which we support life. The scientific mind calls it the electron; the religious mind calls it God. The Indian mother taught her children that "God is one, but He is called by many different names; why quarrel about names?" Is the name so very essential? If we must give a name to this principle, I like to think of it in terms of the All-Creative Spirit, the vital force in every atom and electron of natural resources, and that this Creative Spirit is the will to do in mankind. Considered in this light, is it so difficult to attain a consciousness of God the Creator working out His destiny through us as mediums? We know not for what purpose or for what ultimate destiny. Is it not time for us to get into harmony with this great Creator, this vitalizing force? *(Concluded on page 44)*

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*From a painting © by Gerrit A. Beneker*

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## ART AS AN AID TO INDUSTRY

(*Concluded from page 42*)

That phase of the Creative Spirit by which we support life becomes organized today in the form of industry with the result that the coördination of this spirit in natural resources and in man becomes a real problem. It has been the suppression and exploitation of the creative spirit in industry that has led the world not only to international war to control more of the earth's surface, markets, and trade routes, but to strife and misunderstanding within the borders of every community, sanctioned in the name of competition.

There have been many teachers of the life, growth, and service of this Creative Spirit, but I like to think of the greatest teacher of all as a working man, who once helped to support a family of eight people by his own trade. This working man was The Carpenter of Nazareth, who went "round about the villages, teaching." Here we find an artist in the highest sense, drawing his word-pictures always from nature and human nature. His teaching was not to condemn the law and the prophets, but to fulfill; he came that we might have life and "have it more abundantly." This should be our task today — to try to bring to fulfillment, to perfection, the real purpose of this universal Creative Spirit called industry. Are we willing to admit that the human mind that has given us the perfect working motor which carries us across land and sea, the electric light, the radio, and many other blessings of life is incapable of perfecting the art of controlling these things in a way that will make for peace, understanding, and service to Society? Emerson did not need to know how to put paint on canvas in order to tell us that art could raise to a divine use our material creation.

## INDUSTRY AND ENGINEERING IN THE UNION OF SOCIALIST SOVIET REPUBLICS

(*Continued from page 17*)

above material considerations. However, all this may merely be the result of years of persecution at the hands of the former Imperial Government and of world ostracism since the revolution.

At a dinner the other evening one of the responsible government officials asked me what I thought of Litvinov's reply to Secretary Stimson's note of a few months ago on the Chinese Eastern Railway question, and I told him frankly that I thought it was very discourteous and that Litvinov had missed a great opportunity. To which he observed that Litvinov's foreign policy was unlike that of his predecessor and chief, Chicherin, in that the former preferred to speak out bluntly and without equivocation. He added further this significant comment, that the U. S. S. R. would not knuckle down to any country, nor would it take any attitude in its foreign relations that might be misconstrued as servility, even if that power were the United States. As I see how the minds of some of the men in power work, I am inclined to think that the Foreign Secretary and his confrères of the U. S. S. R. are probably suffering from an inferiority complex, which prompts a belligerent attitude in (*Concluded on page 46*)

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## INDUSTRY AND ENGINEERING IN THE UNION OF SOCIALIST SOVIET REPUBLICS

*(Concluded from page 44)*

their dealings with foreign nations, especially if by any stretch of the imagination they can construe the remark or action of a foreign power as an encroachment upon the sovereign rights of the U. S. S. R. This attitude of conscious weakness must be taken into consideration in dealing with them. It is interesting to recall the insolent notes that our State Department received from Mexico between the years 1916 and 1924 in response to its polite queries. During those years of Mexican revolution and non-recognition the struggling revolutionary government was on the defensive, and was suspicious of every move that we made. That belligerent and offensive attitude disappeared promptly when the Mexican government was recognized by the United States and diplomatic relations were resumed. Mexico was then assured that we had nothing but good will for her people. And in the same way, with the re-establishment of diplomatic relations between Great Britain and the U. S. S. R., most of the misunderstandings, as well as much of the misinformation previously current in the press of both countries, have disappeared. The new British Ambassador here is a man of broad, liberal ideas, of large understanding and tolerance, and is approaching his difficult task with an open mind.

*(To be concluded in the November issue.)*

---

## A TEMPLE OF LIGHT

*(Continued from page 24)*

vivid and artistic limning, the descent of the Holy Spirit.

"The numbers 9 and 19 recur again and again in the structure of the temple, illustrating its basic principle of Unity — nine being the number of perfection, containing in itself the completion of each perfect number cycle, and 19 representing the Union of God and man, as manifested in life, civilization and all things."

THE construction of the ornamental surface structure may involve new materials and a new technique of construction. Studies are being made concerning the possible use of such materials as architectural concrete, terra cotta, cast iron and the aluminum alloys.

The very nature of this remarkable design precludes the use of natural stone on account of the expense of carving and lack of permanency under the severe climatic conditions that obtain at the site of the Temple. On the other hand, a plastic material such as concrete or a metal is especially adapted for this structure. Architectural concrete or cast stone would be economical as the component materials are available universally, and are relatively low in cost. As there will be a great deal of duplication of tracery and ornamentation, the *(Concluded on page 48)*


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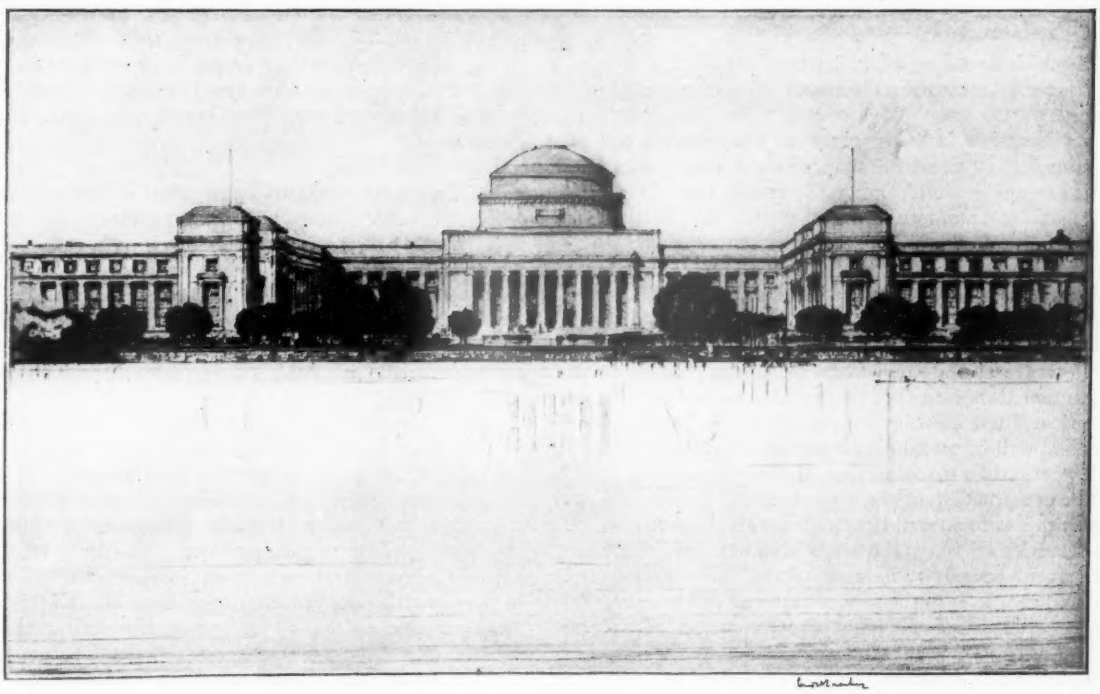

# ANNOUNCING AN ETCHING OF M. I. T.

*By Louis Conrad Rosenberg*

To Be Published Exclusively by The Technology Review On October 15

MR. ROSENBERG, one of the few great American etchers, and a graduate of M.I.T. ('13), has executed a plate of the Institute's Main Group of Buildings that admirably exemplifies his supremacy as an etcher of significant architectural form. ,,, Out of the one hundred and seventy-five prints that were pulled before the plate was destroyed, one hundred and fifty prints are available for sale at $35.00 each. ,,, The size of the etching is 13″ x 8″ and each print is mounted with a mat, size 22″ x 16½″, ready for framing. Each print is signed by Mr. Rosenberg.

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## A TEMPLE OF LIGHT

(*Concluded from page 46*)

same molds and forms can be used repeatedly to cast the surface structure in sections to be subsequently erected.

Consideration is being given to the possible use of aluminum alloy structural shapes for the dome framing to effect savings in weight and maintenance cost. Considerable metal of a non-ferrous nature will be used in the door and window frames, and possibly in some of the ornamental window panels.

The research into materials includes the actual testing of two full size models of a 10-foot section of a dome panel; one section is made of the Earley type of architectural concrete, and the second section is molded of an aluminum alloy furnished by the Aluminum Company of America. These castings are placed on the Temple property and will be tested over a period of years for durability, weathering, discoloration, and appearance.

The construction of the superstructure framework has begun this fall and will be completed about December 31. The exterior ornamental work will be handled in separate subsequent contracts. In view of the elaborateness and unusual character of the surface material and tracery, this work will probably extend over a period of several years.

The late Mr. Louis Bourgeois of Wilmette, Ill., was the architect, Mr. Benjamin B. Shapiro of Chicago, Ill., the structural engineer, and The Research Service, Incorporated [Frederick H. Newell, '85, President, Allen B. McDaniel,'01, Secretary-Treasurer], Washington, D. C., is representing the Temple Trustees as Managing and Supervising Engineers. The George A. Fuller Company of Boston and New York is to construct the superstructure.

ONE naturally seeks to know what is behind such a remarkable concept and what it means to humanity. The Baha'i Movement, or Bahiism, which is building the Temple, is a religious movement, which was founded in Persia in 1844, by Mirza Alī Muhammed of Shīrāz, and has millions of adherents throughout the world at the present time. Its universal teachings were proclaimed to the world by Bahā'u'lláh, which means Glory of God.

'Abdu'l Baha', the son of Bāha' u 'lla'h, made a western tour in 1912 and 1913, speaking in many American and European churches and universities. He laid special stress upon the following universal principles: the independent search for truth; the oneness of mankind; the abolition of racial, patriotic, political, religious prejudices; universal peace; an international court of arbitral justice; the harmony of science and religion; the essential oneness of all religions; the betterment of morals; economic righteousness and justice; universal education; the equality of men and women; and a universal auxiliary language.

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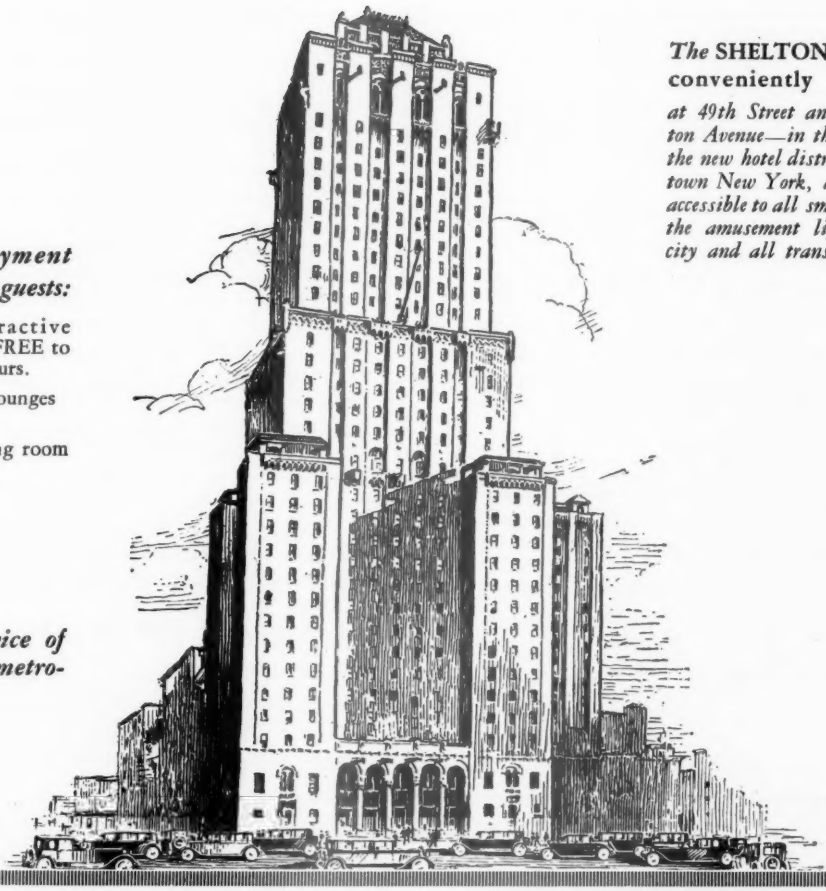

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# LOOKING INSIDE THE ATOM

*(Continued from page 21)*

at a certain distance from the atom's center. In the present case we cannot ascribe this diffuseness to thermal motion, for such motion cannot affect the scattering by gases. The diffuseness is rather of the type predicted by the newer quantum theories. Thus, the broken line shows Pauling's calculation[14] of the electron distribution in the helium atom, based on Heisenberg's theory. The agreement with the observed distribution is striking.

It should be noted, however, that this agreement occurs only in case we use Heisenberg's interpretation of the function $\psi\psi^*$ as meaning the probability of the presence of an electron. Should we instead assume $\psi\psi^*$ to represent the volume density of continuous electric charge, as Schrödinger originally supposed, we should calculate the intensity of scattering shown by the dotted line of Figure 4, which is far from the experimental values.

It thus appears that the Heisenberg form of helium atom is the only one which is in satisfactory agreement with these scattering experiments.

## *The Effect of Thermal Motion*

INTERESTING results follow also from the application of these ideas to the scattering of x-rays by heavier gases. Figure 6 shows the electron distribution in argon as

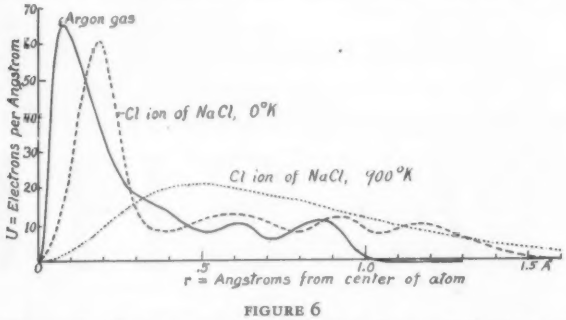


FIGURE 6

*Electron distribution curves showing the effect of thermal agitation and zero point energy on the positions of electrons in crystal lattices.*

calculated from a combination of the data obtained by Barrett[15] and by Herzog.[16] For comparison there is shown in the same figure the electron distribution in the Cl ion of rock salt as determined[17] for the absolute zero (broken line) and at a temperature approaching the melting point (dotted line). Except for small effects which may be due to experimental error, since chlorine and argon differ in atomic number by only one, the differences between these three curves is presumably that resulting from thermal motion. For the solid line this motion plays no part. For the broken line it is chiefly the zero (*Concluded on page 52*)

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## LOOKING INSIDE THE ATOM

*(Concluded from page 50)*

point motion that is effective, and for the dotted line we have both the zero point motion and the thermal motion. The effect of the thermal motion is clearly apparent, and it would seem that the presence of a zero point motion is also indicated. Before this can be considered established, however, it will be necessary to obtain more reliable data on the scattering by argon gas.

We may accordingly say with some confidence that the aspect of the problem of atomic structure which is concerned with the distribution of the electrons in atoms is finding a satisfactory solution. It is a relief to note that a theory is at hand which affords a reasonable interpretation of the experimental electron distributions.

In 1922, having experiments of this character in mind, I had the temerity to predict[18] that within ten years the electron positions in the lighter atoms would probably be known as reliably as were at that time the positions of the atoms in certain crystals. I believe that prediction is now verified. For this information regarding electron positions in atoms is based upon precisely the same principles as is, for example, our information regarding the position of the oxygen atoms in a calcite lattice.

I suppose it would be fair to say that experiments such as these come the closest of any yet performed to showing us "what the atom looks like." For after all is not seeing an object a diffraction phenomenon similar to those under discussion? When we thus "look" at the atom of helium we find it, as illustrated in figures 5 and 6 and by the photograph on page 19, composed of a diffuse electron cloud, concentrated near the center of the atom.

[1] E. A. Owen, *Proc.* Camb. Phil. Soc. *16*, 165 (1911)
[2] J. A. Crowther, *Proc.* Camb. Phil. Soc. *16*, 367 (1911)
*Proc.* Roy. Soc., *86*, 478 (1912)
[3] D. L. Webster, *Phil. Mag. 25*, 234 (1913)
[4] C. G. Darwin, *Phil. Mag. 27*, 315 (1914)
[5] P. Debye, *Ann. d. Phys. 46*, 809 (1915)
[6] A. H. Compton, *Nature*, May 27, 1915; *Phys. Rev. 9*, 29 (1917)
W. H. Bragg, *Phil. Trans.* A. *215*, 253 (July, 1915)
[7] A. H. Compton, *Phys. Rev. 10*, 95 (1917)
[8] W. L. Bragg, James and Bosanquet, *Phil. Mag. 41*, 309 (1921)
[9] W. H. Bragg, *Proc.* Phys. Soc. London, 33, 222 (1921)
[10] W. Duane, *Proc.* Nat. Acad. Sci., *11*, 489 (1925)
[11] A. H. Compton, "X-rays and Electrons," Chap. V (1926)
[12] A. H. Compton, *Phys. Rev. 35*, 925 (1930)
[13] C. S. Barrett, *Phys. Rev.* 32, 22 (1928)
[14] L. Pauling, *Proc.* Roy. Soc. A, *114*, 181 (1927)
[15] C. S. Barrett, *loc. cit.*
[16] G. Herzog, *Helv. Phys. Acta.* 2, 217 (1929)
[17] James and Firth, *Proc.* Roy. Soc. A. *117*, 62 (1927)
[18] A. H. Compton, *Bull.* Nat. Res. Council No. 20 (1922)

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# SAVING COAL BY SCIENCE

*(Concluded from page 18)*

The work at the Institute of Technology has thus been in progress for some eight years and promises to continue for a few years. Dr. Leighton B. Smith, Assistant Professor of Physico-Chemical research, has been associated with the Institute's portion of the program during the entire period of patience-trying experimentation.

At the Berlin meeting Great Britain, Germany, Czechoslovakia, and the United States were represented — the American delegates to the Conference being sent by the A. S. M. E. Research Committee. The program adopted has been to establish a network of fixed points in the saturated and superheated region of steam, at each of which a value has been agreed upon and also a "tolerance" or measure of uncertainty in the values adopted by the international conference. The result is not a steam table but a skeleton of such a table having international indorsement.

The great value of the agreement reached at Berlin, relates to the expectation that the internationally agreed-upon points will be periodically revised. The Berlin conference disclosed in general an astonishing degree of concordance between the various experimental values proposed; both with respect to the direct experimental data and computed quantities obtained by applying the two principles of thermodynamics. A third conference will probably not be required before 1935.

## *The Economic Values*

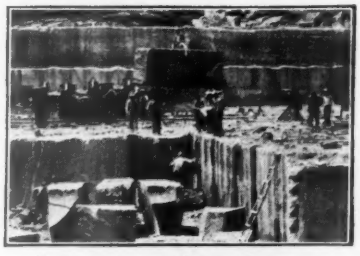
IN 1921 the available data on steam did not exceed that obtainable below 200 lbs. per square inch. In December 1923, the new experimental work had been extended to 600 lbs. per square inch and 650° F.; while in 1924, the first steam turbine operating at 600 lbs. per square inch was placed in operation. By 1925, the first 1,000-lb. turbine was operated, and in the same year the first tentative chart prepared by the Engineers of the General Electric Company was prepared with the new data as a basis. The chart extended to 1,200 lbs. and 800° F. The first 1,200-lb. turbine was placed in service in 1926. The value of the new data, now published in the form of tables, is evident since there are now in operation or under construction over half a million kilowatts in turbine generator sets operating at 1,200 lbs. pressure. (March 1930.)

It may be imagined that an advance of this economic importance might have been taken without knowledge of the advantages to be gained or the capacities which would result, provided the purchasers of machines would take the risk. Without attempting to debate such a proposition, the fact is that as a consequence of the new investigations each step in high pressure steam utilization has been taken with entire assurance that the results obtained would be realized with accuracy.

Who can place a money value on the value of definite knowledge that results will be realized as expected? In any event it is certain that had accurate scientific data not been available and estimates been erratic, the sound progress of the industries now profiting by the economies possible with the use of high pressure steam would have received setbacks representing great economic losses.

# Indiana Limestone in Cleveland's Newest Tower

*Terminal Tower Group, Cleveland, Ohio. Graham, Anderson, Probst & White, Architects. John Gill & Sons, Builders. Built of Gray Indiana Limestone.*



*Quarry view, Indiana Limestone Company, Bedford, Indiana.*

TOWERS of fine-grained, light-colored Indiana Limestone are now conspicuous on the skyline of every larger city. A noteworthy example is Cleveland's Terminal Tower. Modern business has approved the use of natural stone for today's office building. The reason is the proven value of stone as an income producer.

Where land values are high, every precaution is taken to assure a building's drawing power. Surveys in metropolitan areas show that Indiana Limestone buildings have a better than average renting record. The percentage of occupied space in Indiana modern stone structures is unusually high.

This indication of public approval means much, whether your building is a many-storied tower or an apartment or store building. Indiana Limestone is so moderate in cost that it is being used quite as extensively in small buildings as in the larger structures.

Before you commit yourself to building of any other material, no matter what type of construction you are undertaking, get a figure on its cost in Indiana Limestone. Our branch offices, located in principal cities, make this information quick and easy to obtain. We will gladly estimate without the slightest obligation. Put us in touch with your architect.

An illustrated booklet showing modern Indiana Limestone buildings will be mailed free. Please address your inquiry to Dept. 2126C, Service Bureau, Bedford, Indiana.

## INDIANA LIMESTONE COMPANY

*General Offices:* **Bedford, Indiana**

*Executive Offices:* **Tribune Tower, Chicago**

# SIMPLEX
## NON-METALLIC UNDERGROUND CABLE

TYPE R J

Simplex Non-Metallic Underground Cables provide a thoroughly dependable means of underground distribution at reasonable cost.

These cables are made in two types, Type W P protected by a series of weatherproofed tapes, and Type R J protected by a rubber jacket and weatherproofed tapes.

They are recommended for municipal street lighting, "white way," traffic signal installations, park, playground, or airport lighting and low voltage power distribution.

Simplex Non-Metallic Underground Cables are acid, alkali and water proof. They are light in weight, more flexible than cables protected by metallic sheaths and can be easily and quickly installed. Write for more complete information.

SIMPLEX WIRE & CABLE Co

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PHILADELPHIA, 1227 Fidelity-Philadelphia Trust Building
JACKSONVILLE, 417 Barnett National Bank Building


# THE TABULAR VIEW

IN HIS article, "Prometheus Enchained," as in many of his books, Stuart Chase is interested in the ultimate destiny of machine civilization, with a sympathetic turn to the laborer's point of view. He believes that the engineer with his specialized knowledge of the intricate workings of this "Age of Energy" is obviously the one to whom the world should look for guidance. It is not enough that the engineer should invent and execute; he should direct and control the forces which he has set in motion. Mr. Chase writes in an admirably clear and robust style about the engineer's opportunities and responsibilities. ¶ He was born in Somersworth, N. H., in 1888. After spending two years at Technology, he transferred to Harvard College from which he was graduated in 1910. Aside from his work on the Federal Trade Commission and on the Labor Bureau (since 1914), Mr. Chase has found time to write some interesting and informative books on recent economic developments. His book "Men and Machines" was reviewed in the November, 1929, Review. In that same issue he contributed an article entitled "A Billion Wild Horses" continuing the trend of thought in "Men and Machines," and his recent book "Prosperity, Fact or Myth" is the one from which he quotes at the beginning of "Prometheus Enchained."

TEN million people should give thanks for the completion this year of the reservoir segment of a mighty balance wheel of the Hudson River. The Conklingville Dam, creating the Sacandaga Reservoir, a body of water equal in size to Lake George, is described in an authoritative article on page 70 by Edward H. Sargent, Chief Engineer of the Hudson River Regulating District. The magnitude and success of this undertaking is of especial interest to engineers and those interested in the control and efficient use of the country's water resources. Mr. Sargent has played a major part in the development of this project and there is likelihood that the authorities of New York State may name the new reservoir Lake Sargent. ¶ Mr. Sargent is a native of Newburyport, Mass., and was graduated from the Institute in 1907. Previous to his work on the Sacandaga Reservoir, he spent some ten years as assistant engineer in charge of water power investigations in New York State, including the design and construction of Crescent and Vischers Ferry hydro-electric plants on the Mohawk River. In addition to his activities as Chief Engineer of the Hudson River Regulating District, he has been chairman of the Power Division of the American Society of Civil Engineers since 1927.

AS AN expert in instalment finance, Otto C. Lorenz, '18, has been called on recently to handle some important tasks in America and abroad. Mr. Lorenz made a special survey to establish an instalment finance plan for a subsidiary of the Studebaker corporation in Venezuela and other South American countries in 1928. The following year he did organization work in Switzerland in connection with the International Credit and Securi-

*(Concluded on page 62)*

# JOHNSON HEAT AND HUMIDITY CONTROL

## CITY HALL . . Duluth, Minn.

Thomas J. Shefchik, *Architect* . . Duluth, Minn.
Charles Foster, *Engineer* . . . . Duluth, Minn.
Carlson Brothers, *Contractors* . . Duluth, Minn.

VACUUM steam heating, with five ventilating units serving various separate departments are in this building. Johnson Dual Control with 120 thermostats and complete control on all ventilating units is installed.

Under this arrangement the departments that are used only during office hours are heated to seventy degrees during such periods of occupancy and are set back to fifty degrees during the time which they are not in use. The police department and signal department are used twenty-four hours a day and are carried at normal temperatures at all times. In this particular case the steam is purchased and considerable saving results from the use of dual control apparatus.

The ventilating units for the court rooms, council rooms, jury rooms and general office are arranged in accordance with the best ventilation engineering practices, so that air will be supplied at a constant temperature and humidity.

A unique feature of this installation is the heating of the main entrance vestibules by fan units and an arrangement of control by which these vestibules are maintained at a constant temperature, and there is never a draft of cold air due to opening of outside doors, which is a prevalent condition in the ordinary building in Duluth where very severe climatic conditions occur.

## Nearly Every Day Some New "Service" Feature Is Added To Johnson Control . . . . .

Forty-five years ago The Johnson System Of Heat & Humidity Control was placed on the market.

It was the first successful method of complete temperature regulation.

Every notable advance in heat and humidity control apparatus since has had its origin with this company.

Although satisfactorily serving its users, this company is never fully satisfied with the product.

Search for the better is constantly conducted.

Nearly every day new service features are added; minor some of the times but yet advisable.

*Every Johnson installation is inspected annually, without charge.*

And with 30 branches located geographically convenient to every city in United States and Canada, Johnson emergency attention is given within 24 hours anywhere.

That is the reliability behind Johnson Heat & Humidity Control.

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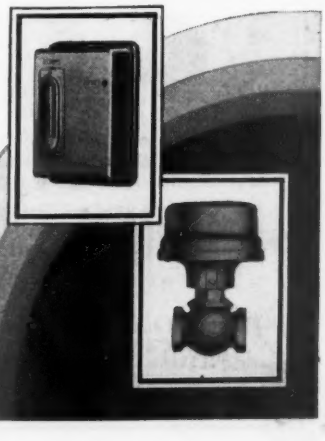
149 E. Michigan St. MILWAUKEE, WIS.
*Established 1885*

The All-Metal System.

The All Perfect Graduated Control of Valves & Dampers.

The Dual Thermostat (Night & Day) Control: Fuel Saving 25 to 40 Per Cent.



**J. G. RUSSELL COMPANY**
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*Designers and Builders*
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**TOOLS, GAGES, AND SPECIAL MACHINERY OF ALL KINDS**

Our firm is equipped to make machinery repairs in record time. Our past experience in eliminating expensive shut-downs is exemplified in the work executed for the Milton Ice Co., Milton, Mass.

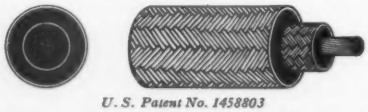
*Address all inquiries to*

**J. G. Russell, '13** *or* **H. Russell, '16**

B.I.W.

**High Tension Wires for Oil Burner Ignition**

**with flameproofed interlayer braid in the wall of rubber insulation**



*U. S. Patent No. 1458803*

**For domestic oil burners utilizing the safety and economy of electric spark ignition. B. I. W. Interlayer Braid oil burner ignition wire provides:**

1. **Protection against the absorption of oil**
2. **Two flameproof braids, one within the insulation**
3. **Ample insulation to withstand the high voltage**

**For 25 years manufacturers of high grade rubber covered wires and cables**

**BOSTON INSULATED WIRE and CABLE COMPANY**
**Boston, Mass.**

# THE TABULAR VIEW

*(Continued from page 60)*

ties Corporation, established for the purpose of purchasing instalment paper arising from the sale of American goods. This work has required special studies of the mathematics of instalment selling and of the statistical, the accounting, and the budgeting procedures involved. ¶ The Review is the first magazine to publish the Equation of Stability, evolved by Mr. Mott-Smith who is associated with Mr. Lorenz. This equation, a single application of which is given, is unusually significant in the world of finance, and the other material included in this article presents the newest and most advanced methods for attacking the problems of instalment finance.

RUSSIA is the great enigma of modern times, and intimate, first-hand information about it is invaluable to an intelligent appraisal of the astounding experiments now being made there. The engineer is playing an essential part in the changing order and is therefore able to learn much more about actual conditions. ¶ As mentioned in the October Review, the article "Industry and Engineering in the Union of Socialist Soviet Republics" represents the experience and impressions of an American engineer on his second professional visit to Russia and originally was not written for publication. For this reason the writer prefers to be known as An American Engineer.

WASHINGTON has fittingly become one of the world's loveliest capitals, but people admiring it as such are generally unpercipient of the elements that make up its beauty, and ignorant of the arduous and complicated planning and engineering upon which that beauty so gracefully rests. In the past many people, too, thought more about the beauty of Washington than about its livability, with the result that recent years have necessitated great changes in its organic structure. All of these things George A. Ricker reviews in "The Washington Nobody Knows." As a resident of Washington for 12 years, and as a sometime member of the Coördinating Committee of the National Capital Park and Planning Commission of the District of Columbia, he writes out of first-hand knowledge. ¶ Mr. Ricker received his elementary education aboard ship with his father, an old-time merchant sea captain. After his graduation from the Institute in 1886, Mr. Ricker's professional career led him into interesting channels. He built the Niagara Gorge Railroad, Buffalo Traction Company's lines, and served as engineer of the Buffalo Creek. As First Deputy Commissioner of highways in New York, he was active in the reorganization of the engineering corps, and rewrote the state highway specifications. He also designed the first steel and concrete railway track. Aside from his special interest in Civil Service Reform, he writes articles on engineering for technical journals and societies.